TO STUDY FLOW CHANGES IN MATERNAL OPHTHALMIC ARTERY IN CASES OF PREECLAMPSIA AND ITS COMPARISON WITH NORMOTENSIVE PREGNANT FEMALES

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DECLARATION BY THE CANDIDATE

I hereby declare that the thesis entitled **"TO STUDY FLOW CHANGES IN MATERNAL OPHTHALMIC ARTERY IN CASES OF PREECLAMPSIA AND ITS COMPARISON WITH NORMOTENSIVE PREGNANT FEMALES"** submitted towards partial fulfillment of the requirements for the award of **MD RADIODIAGNOSIS** degree to BFUHS is a compilation of original work carried out by me under the supervision of **Dr. Ritu Dhawan Galhotra,** Professor, Department of Radio-diagnosis, **Dr. Sunil Kumar Juneja**, Professor, Department of Obst. & Gynae. **Dr. Siddharth Prakash**, Associate Professor, Department of Radio-diagnosis. No part of this thesis has formed the basis for the award of any degree previously.

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Dedicated

to

my family

&

Teachers

LIST OF ABBREVIATIONS

PI	–	Pulsatility index
RI	–	Resistivity index
PR	–	Peak Ratio
PDV	–	Peak diastolic velocity
PSV	–	Peak systolic velocity
OAD	–	Ophthalmic artery Doppler
PE	–	Pre eclampsia

ABSTRACT

Introduction: Pre-eclampsia is a multisystem disorder characterized by hypertension in pregnancy (Pregnancy induced hypertension) with proteinuria in a previously normotensive and non-proteinuric woman. It is associated with the various neuro-ophthalmic manifestations, which can be evaluated by Ophthalmic artery dopplervelocimetery. Various parameters of Ophthalmic artery Doppler can be calculated which can show the effects PE on cerebral vasculature.

Aims- 1.To study hemodynamic changes in maternal ophthalmic artery by color doppler in cases of PE. 2. To compare the parameters with normotensive pregnant females. 3. To correlate the findings with the severity of the disease.

Methods: Pregnant females who were diagnosed with pre eclampsia and referred for Ophthalmic artery Doppler to Deptt. ofradiodiagnosiswereincluded in the study.Study was conducted over a period of one year.Linear Probe (6-15Hz) was used and Ophthalmic artery doppler parameters were documented.

Results : Resistivity index andpulsatility index were significantly(p value = 0.001) lower in pre eclamptic women than the controls whereas peak ratio and peak diastolic velocity were significantly (p value = 0.001) higher than the normotensive females. PI showed maximum sensitivity of 98% in right eye and 96% in left eye in detection of pre eclampsia whereas Peak Ratio showed maximum specificity of 98 % in right and 96% in left eye.No statistical parameter was found to be clinically significant to distinguish between mild and severe pre eclampsia.

Conclusion: Ophthalmic artery Doppler is a cheap, easily available and non invasive tool for assessment of hemodynamic changes in patients of pre eclampsia which can be helpful in prevention of cerebral complications.

Keywords: Ophthalmic artery Doppler, Preeclampsia, Eclampsia ,Proteinuria

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INTRODUCTION

Hypertension is one of the most common complications during pregnancy. It encompasses a group of conditions named preeclampsia, eclampsia, chronic hypertension and gestational hypertension[1] complicating 10% of all pregnancies.[2]

Preeclampsia is a major cause of maternal death, IUGR and most of these deaths result from brain damage. In addition to related mortality and morbidity,PE contributes to the adverse long term cardiovascular sequelae of affected women.[3,4]

Pre-eclampsia is a multiorgan disease characterized by hypertension in pregnancy (Pregnancy induced hypertension) with significant amounts of protein in the urine. [5]

It is defined as elevated blood pressure >140/90mmHg taken on two consecutive occasions at least 6 hours apart and the presence of proteinuria >300 mg in a 24 hour sample (or 1+ on dipstick random urine test) after 20 weeks in a previously normotensive and non proteinuric woman that resolves 6 week postpartum. It can be classified into mild and severe forms depending upon various lab and clinical parameters.[6,7]

Various recent studies showed that PE can be divided into early and late onset PE [7,8] and they have a different underlying pathophysiological origin[9,10] Early-onset PE (that requiring delivery <34 weeks' gestation) ismore commonly associated with intrauterine growth restriction (IUGR) and various maternal and perinatal adverse effects[11,12] In contrast, late-onset PE (delivery ≥34 weeks) is usually associated with milder antenatal complications and the perinatal outcomes are usually better.

Various risk factors for preeclampsia are primigravida, family history of preeclampsia, chronic renal disease, chronic hypertension, preceding history of preeclampsia, high body mass index or obesity,

antiphospholipid syndrome, diabetes mellitus, extremes of age (<18 or >40), black race, twin gestation and presence of angiotensinogen gene.[13,14] But still , reason behind the preeclampsia is unknown.[13,14]

Untreated PE can lead to Eclampsia, this is defined as PE complicated with convulsions and or coma, as it is associated with abnormalities in intracerebral blood flow.[15]

The clinical diagnosis include presence of higher BP and proteinuria ,persistent visual disturbance and headache as well as epigastric pain. Symptomatically persistent headache and persistent visual disturbance have been documented as sufficient criteria to identify worsening of a pre eclamptic condition. Visual symptoms can occur in 30 to 100% of patients with PE.[16]

Although its pathophysiology is still not entirely understood, it is certain that preeclampsia involves endothelial dysfunction with vasospasm,arterial constriction, reduced intravascular volume and impairment of organ perfusion.[17,18] This can lead to hemodynamic changes that can affect the internal carotid, ophthalmic artery circulation which can result in neuro-ophthalmic manifestations.

So the ophthalmic artery doppler can be useful for evaluating the intracranial vascular dynamics in PE due to the fact that it has similar embryologic origin to that of the intracranial vessels and has anatomical continuity with the intracerebral circulation.[19,20]

Ophthalmic artery is the first branch of internal carotid artery and its assessment is easy as compared to other intracranial vessels.

Number of studies have already demonstrated that in PE, impedance to the flow is decreased with resultant increase in velocity of the flow.[21-32]

MRI can be safely used to study intracranial blood flow in pregnancy, however it is not readily available or cost effective and is contraindicated such as those with ferromagnetic implants. Other

modalities such as CT angiography and radionuclide imaging makes use of ionising radiations which can be hazardous to fetus and therefore contraindicated in pregnancy.[33]

The transcranial doppler ultrasound can be the other modality to study intracranial vessels. However it is not simple to use and has poor spatial resolution.[28]

So, Ophthalmic artery doppler is the best modality to study hemodynamic changes in cerebral vessels and can help to assess the cerebral effects of preeclampsia.

It is safe in pregnancy, cheap, readily available ,portable ,repeatable and non invasive.The lack of bony, fatty or gaseous structures in the eyeballs makes insonation of the ophthalmic artery by transorbital route technically feasible.

Various parameters can be calculated by Ophthalmic artery doppler such as Peak systolic velocity (PSV), Peak diastolic velocity (PDV), Resistive Index (RI), Pulsatility index (PI), Peak Ratio (PR).

These are objective parameters which are not operator dependent which will also remove interobserver variability associated with other modalities.

Various Doppler parameters used for evaluating the flow in the ophthalmic artery, include the resistivity index (RI), pulsatility index (PI), peak systolic velocity (PSV), peak diastolic velocity (PDV), end diastolic velocity (EDV), and peak ratio.[29]

PEAK RATIO:

It is the ratio of the PDV to the PSV,

PR = PDV/ PSV

It is very useful in assessment of ophthalmic artery blood flow in the hypertensive state.[33]

PULSATILITY INDEX:

It is calculated as is PSV-EDV/TAMAX, where TAMAX is time-averaged maximum

PI = PSV-EDV/TAMAX

RESISTIVITY INDEX :

It measures resistance distal to the point of measurement and is obtained only at an instant in the cardiac cycle.

RI = PSV-EDV/PSV

The measurement of OAD parameters hold varying significance in analysing the various hemodynamic changes associated in PE.

The RI and PI are usually preferred over PSV and EDV in the evaluation of the ophthalmic artery, as these both parameters are independent on the angle of insonation, whereas the PSV and EDV depend on it and can result in skewed values.

There is also more variability between the PSV and EDV for both eyes, unlike the good correlation for PI and RI values obtained from both eyes.[21,33,34] The RI is good for evaluating waveforms with high systolic and diastolic flows,. It has been found to be more useful than the PI in the study of the ophthalmic arteries.[35]

In the developed world, Ophthamic artery Doppler studies have been done in pregnant women with hypertensive disorders such as PE,[22,25,29,36] following the OAD evaluation in pregnant women with PE first done by Hata et al in 1995.[22]

However, there is a paucity of information on this subject in this environment despite the fact that pregnancy-induced hypertension contributes significantly to high maternal mortality.[1] To our knowledge, this study appears to be the first to evaluate the hemodynamics of the ophthalmic artery in PE in this environment. The aim of this study was to document the hemodynamic changes in PE using the OAD ultrasonography technique in singleton pregnancies and compare with those in normotensive pregnant women living in the study region.

These parameters can be used to detect pre eclampsia and can predict its severity, so that appropriate intervention can be made to decrease the morbidity and mortality associated with it.

The continued monitoring during pregnancy and recording baseline parameters can help to detect worsening during the antenatal period which will not only be life saving for mother but can also decrease neonatal mortality rate and other adverse effects of PE on neonates.

AIM AND OBJECTIVES

- To study hemodynamic changes in maternal ophthalmic artery by color doppler in cases of PE
- To compare the parameters with normotensive pregnant females.
- To correlate the findings with severity of the disease.

REVIEW OF LITERATURE

Various studies have been done to study the role of ophthalmic artery hemodynamics in pre eclamptic patients.

M. Hikima (2023) et al has done a study including Ninety-six patients with the clinical diagnosis of PE and 96 normotensive pregnant controls between 20 and 40 weeks' gestational age. Ophthalmic artery Doppler velocimetric indices of the two groups were measured and documented. They have found that mean velocimetric measurements in the control group were as follows: peak systolic velocity (PSV) = 38.04 ± 13.68 cm/s, End-diastolic volume (EDV) =9.14 ± 3.65 cm/s, resistivity index (RI) = 0.75 ± 0.091, pulsatility index (PI) =1.62 ± 0.55, peak mesodiastolic velocity (PMDV) = 21.02 ± 8.83 cm/s, peak ratio (PR) = 0.56 ± 0.14. The mean velocimetric indices in the PE group were PSV = 44.59 ± 11.54 cm/s, EDV = 12.23 ± 2.66 cm/s, RI = 0.71 ± 0.069, PI = 1.67 ± 0.42, PMDV = 32.27 ± 9.12 and PR = 0.72 ± 0.10.

They concluded that there is a significant difference in the ophthalmic artery Doppler velocimetric indices between women with PE and normal pregnant women. It is a useful tool in monitoring the hemodynamic changes in cerebral circulation in Pre eclamptic females.[37]

E. Selima (2022) et al. has done a prospective study comprising 120 pregnant women in total. The control group who remained normotensive throughout pregnancy included were 96 and those who developed preeclampsia (preeclampsia group) were 24 women (16 with mild preeclampsia and 8 with severe preeclampsia).They found that those with preeclampsia had considerably higher ophthalmic artery PSV (P1), 2nd systolic peak (P2), peak ratio (p2/p1), and EDV than patients who remained normotensive.

They reported that Ophthalmic artery PI had sensitivity of 89.7% and specificity of 75.12% at cut off value < 1.76 in predicting pre-eclampsia. Also, ophthalmic artery RI had sensitivity of 80.2% and specificity of

74.9% at cut off value < 0.77 in predicting pre-eclampsia. Peak Ratio (PR) of the ophthalmic artery had sensitivity of 77.3% and specificity of 65.8% at cut off value > 0.59 in predicting pre-eclampsia. In addition, 2nd systolic peak (P2) ophthalmic artery had sensitivity of 91.7% and specificity of 61.7% at cut off value > 20.1 in prophesying pre-eclampsia.

They concluded that Doppler of the ophthalmic artery is an easy, reliable and unbiased technique with a standalone predictive diagnostic value for the development of PE and a promising excellent imaging procedure as the area under the curve for the peak ratio (PR) and the second systolic peak (P2).[38]

M Gana (2022) has done a prospective observational study in women between 11 + 0 to 13 + 6 weeks' gestation and included 4066 pregnancies. They recorded maternal demographic characteristics and medical history, ultrasound examination for fetal anatomy and growth, assessment of flow velocity waveforms from the maternal ophthalmic arteries and calculation of the second-to-first peak systolic velocity (PSV) ratio, and measurement of MAP and serum PAPP-A. In addition, a case-control study was carried out for measurement of PlGF in stored samples from cases that developed PE and unaffected controls. The values of PSV ratio, UtA-PI, MAP, PAPP-A and PlGF were converted to multiples of the median or deltas to remove the effects of maternal characteristics and medical history. The competing-risks model was used to estimate the individual patient-specific risk of delivery with PE at < 37 and < 41 + 3 weeks' gestation for various combinations of markers.

They found that the PSV ratio was significantly increased in PE pregnancies, and the effect of PE depended on gestational age at delivery, with the deviation is more for early than late PE.

They concluded that Ophthalmic artery PSV ratio at 11-13 weeks' gestation is a potentially useful biomarker for prediction of subsequent

development of preterm PE, but larger studies are needed to validate this finding.[39]

M Saleh.(2022) et al has done a study on 795 pregnant females between 28-32 weeks of gestation to undergo uterine and ophthalmic artery Doppler ultrasound. Maternal and fetal characteristics, and pregnancy-associated plasma protein A (PAPP-A) values in the first trimester were also collected.

They have fund that 48 cases progressed to preeclampsia. All assessed ophthalmic Doppler parameters including first and second peak systolic velocities (PSVs), second to first peak ratio (PR), and pulsatility index (PI), were statistically different in patients who developed preeclampsia. The average PR and PI between the eyes, PAPP-A and uterine artery PI were determined to be the most important predictors of PE.

They concluded that PR and PI is a good screening method for individuals at higher risk of progressing to preeclampsia in the third trimester of pregnancy.[40]

I. Sapantzoglouet. al. (2021) has done a prospective observational study of pregnant females between 19 + 1 to 23 + 3 weeks' gestation. Waveforms were obtained from the ophthalmic arteries in both eyes, for the indices: first peak of systolic velocity; second peak of systolic velocity; PI; and the ratio of the second to first peak of systolic velocity (PSV ratio).

They observed that out of 2853 pregnancies contained 76 (2.7%) that developed PE, including 18 (0.6%) that delivered with PE at < 37 weeks' gestation. The ophthalmic artery PSV ratio was significantly increased in PE pregnancies, and the PE effect depended on gestational age at delivery; the deviation from normal was greater for early than late PE. The second peak of systolic velocity was also increased in PE pregnancies, but the effect did not depend on gestational age at delivery. The other two ophthalmic artery indices of

first peak of systolic velocity and PI were not significantly affected by PE. The PSV ratio improved the prediction of preterm PE provided by maternal factors alone (from 56.1% to 80.2%), maternal factors, MAP and UtA-PI (80.7% to 87.9%), maternal factors, MAP, UtA-PI and PlGF (85.5% to 90.3%) and maternal factors, MAP, UtA-PI, PlGF and sFlt-1 (84.9% to 89.8%), at a FPR of 10%. The PSV ratio also improved the prediction of term PE provided by maternal factors alone (from 33.8% to 46.0%), maternal factors, MAP and UtA-PI (46.6% to 54.2%), maternal factors, MAP, UtA-PI and PlGF (45.2% to 53.4%) and maternal factors, MAP, UtA-PI, PlGF and sFlt-1 (43.0% to 51.2%), at a FPR of 10%. The empirical results for DR at a 10% FPR were consistent with the modeled results. The second peak of systolic velocity did not improve the prediction of either preterm or term PE provided by maternal factors alone.

They concluded that the Ophthalmic artery PSV ratio at 19–23 weeks' gestation, both on its own and in combination with other biomarkers, is potentially useful for prediction of subsequent development of PE, especially preterm PE, but larger studies are needed to validate this finding.[41]

Onwudiegwu C et al. (2020) have done a case control study of 71 pre eclamptic women and 72 parity matched normotensive women and demonstrated that, There were no significant differences between cases and controls with respect to sociodemographic variables. The mean pulsatility index was 1.35±0.46 in cases and 2.1±0.4 in controls ($p<0.001$); the resistivity index was 0.7±0.18 in cases and 0.83±0.27 among the controls ($p=0.01$). A similar pattern was observed in the peak systolic velocity ($p<0.001$) and the peak ratio ($p<0.001$). There was no significant difference between the groups concerning end-diastolic velocity ($p=0.535$).

They concluded that Preeclamptic women had significantly lower Doppler velocimetery and impedance parameters among preeclampsia cases compared with controls. Ophthalmic artery doppler parameters

could be useful in identifying those women who are likely to suffer PE and its complications.[42]

S R Madina et al.(2020) has conducted a cross-sectional observational study, ultrasound of the uterine and ophthalmic arteries was performed in 60 pregnant women in the 2nd and 3rd trimester of pregnancy to compare the resistive index of these arteries in preeclamptic and normotensive individuals. They found that the mean resistive index of the uterine artery was 0.50 ± 0.08 in normotensive participants and 0.64 ± 0.09 in preeclamptic women, with the p-value <0.001. The mean resistive index of the ophthalmic artery was 0.70 ± 0.05 in normotensive participants and 0.63 ± 0.04 in preeclamptic women, with the p-value <0.001.

They concluded that there was a significant negative correlation between the resistive index of the uterine and ophthalmic arteries among the patients with preeclampsia and a significant positive correlation among normotensive individuals. Preeclampsia could be easily diagnosed with Doppler ultrasound based on hemodynamic changes in response to vascular changes in the ophthalmic and uterine arteries.[43]

M Sarno et al.(2020) has done a prospective observational study in women between 35 + 0 to 36 + 6 weeks' gestation. They recorded maternal demographic characteristics and medical history and assessment of flow velocity waveforms from the maternal ophthalmic artery. Waveforms were obtained in sequence from the right eye, left eye and again from the right and then left eye. They recorded the average of the four measurements, two from each eye, for the following four indices: first peak of systolic velocity; second peak of systolic velocity; pulsatility index; and the ratio of the second to first peak of systolic velocity (PSV ratio).

They observed that the study population of 2287 pregnancies contained 60 (2.6%) that developed PE, including 19 (0.8%) that delivered with PE at < 3 weeks after assessment. The DR, at 10%

FPR, of delivery with PE at any time after assessment by maternal factors was 25.0% (95% CI, 14.7–37.9%), and this increased by 25 percentage points to 50.0% (95% CI, 36.8–63.2%) with the addition of the adjusted PSV ratio (P = 0.005); the respective values for delivery with PE at < 3 weeks after assessment were 31.6% (95% CI, 12.6–56.6%) and 57.9% (95% CI, 33.5–79.8%). The other ophthalmic artery indices did not improve the prediction provided by maternal factors alone. There was good correlation between the first and second measurements of PSV ratio from the same eye (right eye r = 0.823, left eye r = 0.840), but poorer correlation in the first and second measurements between the two eyes (first measurement r = 0.690, second measurement r = 0.682). In screening by maternal factors and PSV ratio for PE with delivery at any stage after assessment, the estimated DR, at 10% FPR, was 50.0% when the average of four measurements was used (two from each eye), 49.1% when the average of one measurement from each eye was used, 47.3% when the average of two measurements from the same eye was used, and 45.8% when only one measurement was used.

They concluded that Ophthalmic artery PSV ratio at 35–37 weeks' gestation can predict subsequent delivery with PE, especially if this occurs within 3 weeks after assessment.[44]

M. Ozdemir (2020) et al has performed a study consisting of 50 pregnant women with PE and 50 healthy pregnant women. The peak systolic velocity (PSV), end-diastolic velocity, PI, RI, first diastolic peak velocity, systolic/diastolic (S/D) ratio, and peak ratio of the maternal OA were measured by a transorbital Doppler ultrasound (US) scan. The PSV, end-diastolic velocity, PI, RI, and S/D ratio of the CICA were measured. The differences of Doppler indices between groups with P < .05 were considered statistically significant. Cutoff values were calculated, which could be used to predict adverse maternal outcomes and gestational age at birth. They found that The RI and PI values of the OA were lower, and the first diastolic peak velocity, PSV, and peak ratio values were higher among the PE group. The RI and S/D values

of the CICA were significantly lower in the PE group compared to the healthy group. The OA RI was determined to be the strongest US variable in predicting adverse maternal outcomes and gestational age at birth, with a cutoff value of 0.72, 76% sensitivity, and 76% specificity.

They concluded that Maternal OA Doppler indices can be used as US markers to predict adverse maternal outcomes [45]

P De souza (2018) et al performed a prospective observational cohort study on 415 singleton pregnancies. Maternal uterine and ophthalmic artery Doppler examinations were performed between 18 and 23 weeks of gestation. The control and PE groups were compared to continuous variables using the Kruskal-Wallis test and to categorical variables using the Chi-square and Fisher exact tests. Univariate and multivariate logistic regression analyses were performed to determine the best model for the prediction of PE.

They have found that 40 (9.6 %) pregnant women developed PE. They observed significant differences in the body mass index (BMI) ($p < 0.001$), parity ($p < 0.001$), mean arterial pressure (MAP) ($p < 0.001$), and pulsatility index (PI) of uterine artery Doppler ($p < 0.001$) between PE and control groups. The best model for the prediction of PE included maternal characteristics, MAP, maternal uterine and ophthalmic artery Doppler with area under receiver operating characteristics (ROC) curve of 0.710 (95 % confidence interval, 613 - 0.807) with a sensitivity of 45 % to a false-positive rate of 10 % and 35 % to a false-positive rate of 5 %.

They concluded that Maternal ophthalmic artery Doppler did not promote a significant increase in the PE detection rate during the second trimester scan.[46]

M. Chaves (2017) et al has done a Prospective cohort study of 56 women with preeclampsia that underwent Doppler measurements of OA flow. PR results were classified as normal ($PR < 0.78$), abnormal (PR 0.78-0.98), or highly abnormal ($PR \geq 0.99$).They have found that

Adverse maternal outcomes became more frequent as the PR values increased (p=.005). The occurrence of hypertensive crisis after hospital admission (secondary endpoint) was also positively associated with PR values (p=.001). Adverse perinatal outcomes were not associated with PR values (p=.551), but women in the highly abnormal PR group (PR ≥ 0.99) had the earliest deliveries (p=.001) and the smallest newborns (p=.004). All women in the highly abnormal PR group (n=16) had an adverse outcome.

They concluded that Maternal OA Doppler PR ≥ 0.99 in preeclampsia may identify women at increased risk of adverse maternal outcomes and pregnancies at the greatest risk of preterm birth.[47]

Olatunji et al.(2015) have also done a case control study with 42 PE patients and 41 controls and concluded that Mean resistivity index, pulsatility index, and peak systolic velocity were significantly lower in pre-eclamptic patients than in the controls. Mean peak diastolic velocity, end diastolic velocity, and peak ratio were significantly higher in the pre-eclamptic group. The receiver operating characteristic curve showed that the resistivity index (sensitivity 75%, specificity 77.8%) could distinguish mild from severe PE while the peak ratio (sensitivity 90.5%, specificity 81.3%) could accurately detect PE.

So, OAD ultrasound can be used to monitor patients with PE for early detection of progression to severe forms before cerebral complications develop and OAD screening of patients at high risk for PE can also detect early changes of hemodynamic derangement.[48]

D. S. Matias et al.(2014) in a prospective cohort study recruited 347 women of whom 40 developed PE.

A comparison of the mean ophthalmic artery Doppler parameter values between women with and those without PE showed statistically significant differences in several parameters: peak systolic velocity, end-diastolic velocity, mean velocity, peak mesodiastolic velocity

(PMDV) and peak ratio. After adjusting for confounding variables, only PMDV remained statistically significant (P<0.001), with an area under the receiver–operating characteristics curve (AUC) of 0.73. The best cut-off for predicting PE was a PMDV of >22.11cm/s, with sensitivity of 70%, specificity of 75%, positive likelihood ratio of 2.8, negative likelihood ratio of 0.4, positive predictive value of 28% and negative predictive value of 95%. The AUC increased from 0.72 to 0.78 when the PMDV was incorporated into a prediction model based on clinical variables, demonstrating that this marker increased the discriminatory capability of the model.

They concluded that high ophthalmic artery PMDV in the second trimester of pregnancy is an independent predictor of PE[49]

CristianeAlves de Oliviera et al.(2013) compared OAD indices of 30 women with mild pre eclampsia ,30 women with severe preeclampsia and 30 women with chronic hypertension. The control group consisted 289 normotensive pregnant females. They observed significant differences between the resistive index, pulsatility index, and peak ratio in women with severe preeclampsia compared to the other groups. The means ± SDs for the resistive index, pulsatility index, and peak ratio in women with severe preeclampsia were 0.63 ± 0.09, 1.13 ± 0.31, and 0.89 ± 0.12, respectively. The optimal cut off values for the resistive index, pulsatility index and the peak ratio for identification of women with severe preeclampsia were determined by the receiver operating characteristic curves to be 0.657, 1.318, and 0.784.

They showed that the peak ratio was the best index for discriminating between severe and mild preeclampsia or chronic hypertension.[50]

Diniz et al. (2008) studies differences in orbital flow in mild and severe pre-eclamptic women and compared with healthy pregnant women .They matched Ophthalmic artery Doppler indices of 20 mild and 20 severe pre-eclamptic with 51 healthy pregnant women. They observed that Statistically significant differences between PR, PSV, and EDV(P=0.0009,P=0.0020,P=0.0001) of ophthalmic artery Doppler in a

comparison of women with mild and severe pre-eclampsia. Statistically significant differences were seen between all Doppler indexes of the study group and healthy pregnant women. Ophthalmic PR, PSV, and EDV were significantly higher in severe pre-eclamptic cases but other index parameters did not show any difference.An elevation of diastolic and systolic flow occurred when pre-eclampsia became severe. They concluded that Orbital vascular impedance reduction with orbital hyperperfusion was present in severe pre-eclamptic women compared with mild pre-eclamptic and healthy pregnant women.[29]

Tunahan Ayaz et al.(2003) studied Pulsatility and resistivity indices in 30 mild to moderate preeclamptic females with 30 controls concluded that Ophthalmic artery doppler can be used to detect hemodynamic changes that are not present in normotensive pregnant females.[28]

Y Ohno et. al. (1999) has included 118 participantsand they observed that the ophthalmic arterial pulsatility index (PI) correlated negatively with gestational age (y = -0.01x + 1.84, r = -0.41, P<.01). Pulsatility index in preeclamptics with photophobia (0.71+/-0.17) was lowest among the three groups (P<.01) and was highest in normotensive pregnant women (1.41+/-0.21, P<.01). Mean velocity in normotensive pregnant women (0.19+/-0.05 m/second) was highest among the groups (P<.01) and was not significantly different in preeclamptic women with no visual symptoms (0.27+/-0.03 m/second) and with photophobia (0.30+/-0.02 m/second)

They concluded that Preeclamptic women, especially those with photophobia, have orbital vascular vasodilation or hyperperfusion, or both.[26]

T. Hata (1997) et al has done a study including 17 normotensive nonpregnant women, 29 normotensive pregnant women, 9 patients with mild preeclampsia, 6 with severe preeclampsia, 6 with transient hypertension, and 9 with chronic hypertension was studied with color Doppler flow imaging and pulsed Doppler ultrasonography. The mean

arterial blood pressure and the ophthalmic artery pulsatility index were calculated in each group.

They found that the pulsatility index (1.17 +/- 0.08) in severe preeclampsia was lowest among the groups $p < 0.05$), whereas that (2.92 +/- 0.59) in normotensive pregnant women was highest among the groups ($p < 0.05$). The pulsatility index (1.47 +/- 0.30) in mild preeclampsia was significantly lower than that (1.89 +/- 0.27) in transient hypertension ($p < 0.05$). There was no significant difference in pulsatility index between mild preeclampsia and chronic hypertension (1.69 +/- 0.49) or between transient hypertension and chronic hypertension. The pulsatility index inversely correlated well with the mean arterial blood pressure ($R2 = 0.645$, $p < 0.0001$).

They concluded that these results suggest that the lower pulsatility index should be interpreted as orbital vascular vasodilation, indicating orbital hyperperfusion or hyperemia. Changes in pulsatility index in the ophthalmic artery may be indicative of similar changes in other cerebral vessels.[23]

MATERIAL AND METHODS

A study was done on 50 patients with pre-eclampsia referred for Ophthalmic artery doppler to the Deptt. Of Radiodiagnosis at DMCH Ludhiana. 50 Normotensive pregnant controls were matched for maternal age and gestational age were also included in the study.

Patients were examined on LOGIQ E9, or Philips IU22 Machine using a linear probe.

Written consent was taken from each patient in their vernacular language before making her part of the study and relevant history was elicited from each patient.

SONOGRAPHIC Evaluation:

A linear high frequency probe was used to scan the orbit and Ophthalmic artery doppler parameters was documented. The patient was placed in a supine position with a slight lateral left turn. Both eyes were closed and after a resting period of 10 min a small amount of acoustic gel was applied. The transducer was then gently placed horizontally over the upper eyelid and Ophthalmic artery was identified by color doppler. Then pulse Doppler was applied with sample volume placed approximately 15 mm behind the optic disc medial to the optic nerve ,2 ml sample volume was taken. The angle of insonation was kept below 20^{o} and high pass filter was kept to its minimum value. The pulse repetition frequency was taken according to the study. Both Ophthalmic arteries were examined sequentially with parameters of right eye were taken before left. The recorded parameters include PSV, PDV, RI, PI and PR.

Source of Data

The study was conducted on 50 patients with a clinical diagnosis of pre-eclampsia referred from indoor and outdoor obstetric department to the department of radiodiagnosis for sonographic evaluation.

50 Normotensive pregnant controls were matched for maternal age and gestational age were also included in the study.

METHOD OF COLLECTION OF DATA

Pregnant women diagnosed with Pre eclampsia , both inpatient and outpatient or on follow up in Dayanand Medical College and Hospital, Ludhiana were participants in the study. The data was collected by personal interviews / Case Registration file / Investigations done on a routine basis. Details of obstetric history, age, date of last menstrual period, antenatal history of the current and past medical history was taken into consideration followed by sonographic evaluation.

INCLUSION CRITERIA:

- GA >20 weeks, >140/90 on two measurements taken 6hrs apart, proteinuria >300 mg in a 24 hour urine sample or at least 1+ dipstick.

EXCLUSION CRITERIA:

1. History of diabetes or chronic hypertension

2. History of ocular disease

3. History of Vasculitis

Duration of Study/ Number of Cases

50 cases and 50 Controls

The grading of mild and severe eclampsia was done according to BP of patients.

The patients with BP lying between 140/80 to 159/89 were considered mild pre eclamptics whereas BP lying above 160/90 were considered severe pre eclamptics.

OUTCOME:

To analyze hemodynamic changes in Ophthalmic artery doppler in patients with preeclampsia, its comparison with the normotensive pregnant female and its Correlation with the severity of the disease

STATISTICAL ANALYSIS:

Data was described in terms of range; mean ±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. Comparison of quantitative variables between the study groups was done using Student t-test and Mann Whitney U test for independent samples for parametric and non-parametric data respectively. For comparing categorical data, Chi square ($\chi 2$) test was performed and exact test was used when the expected frequency is less than 5. A probability value (p value)less than 0.05 was considered statistically significant. All statistical calculations was done using (Statistical Package for the Social Science) SPSS 21version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

OBSERVATION AND RESULTS

Demographic Data

The present study was conducted on 100 patients, the 50 were pre eclamptic patients and 50 controls were normotensive pregnant females.

In our study no. of patients below the age of 30 years were 62 of which 23 were cases and 39 were controls, between the age of 30-34years the total number of patients were 27 of which 18 were cases and 9 were controls and above the age of 35 years total patients were 11 of which 9 were cases and 2 were controls.(table 1a,:Figure 1)

The Mean age of cases were 30.28±4.92 years and controls were 26.60±4.20 years.(table 1b)

Table 1a : Showing Age distribution of patients

		Cases		Control		Total
		No.	%age	No.	%age	
Age group	20-30	23	46.0%	39	78.0%	62
	30-34	18	36.0%	9	18.0%	27
	>35	9	18.0%	2	4.0%	11
Total		50	100.0%	50	100%	

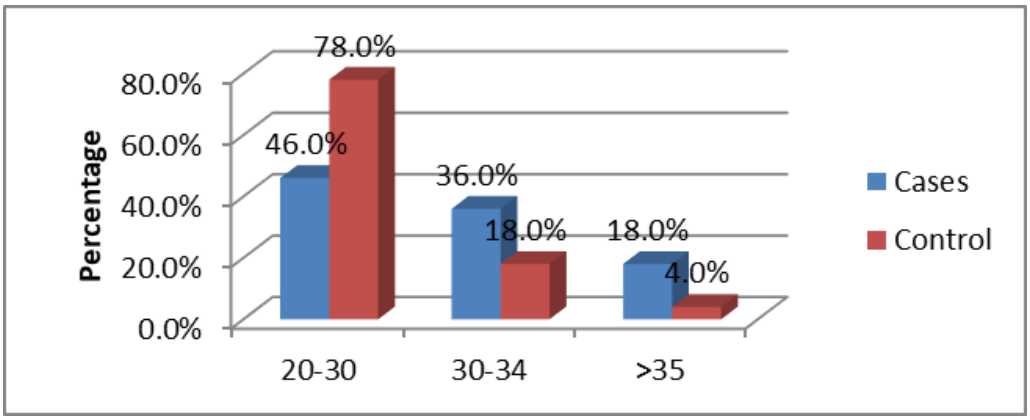

Figure 1 : Showing Age distribution among cases and controls

Table 1b :Showing mean age of patients

	cases		control	
	Mean	**SD**	**Mean**	**SD**
Age	30.28	4.92	26.60	4.20

The total number of participants below the gestation of 32 weeks were 56 which includes 25 cases and 31 controls. Between 32 – 36 weeks of gestational age 19 respondents were cases and 16 were controls. Above 36 weeks of gelation age 6 were cases and 3 were controls.(table 2a, figure 2)

The mean POG of cases was 30.47±4.85 weeks and of controls was 29.32±4.46 weeks.(table 2b)

Table 2a: Showing Distribuition of patients among diferent groups of Period of gestation

		Cases		**Control**		**Total**
		No.	**%age**	**No.**	**%age**	
POG	20-32wk	25	50.0%	31	62.0%	56
	32-36wk	19	38.0%	16	32.0%	35
	>36wk	06	12.0%	3	6.0%	9
Total		50	100.0%	50	100%	

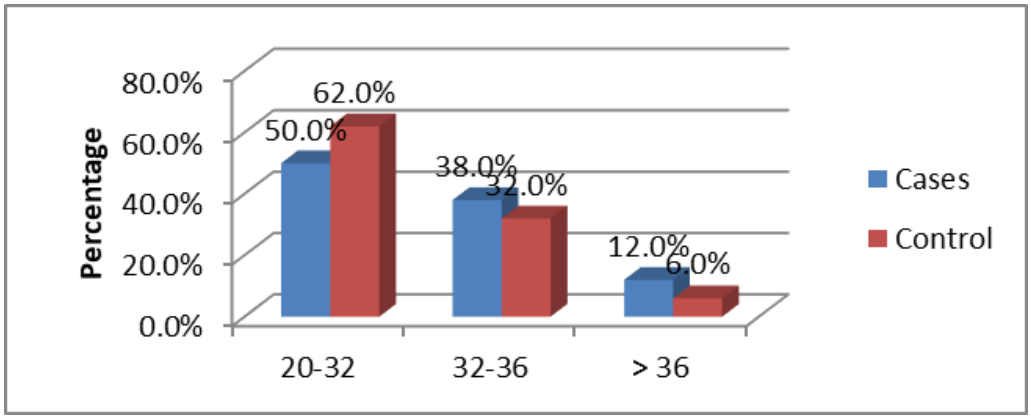

Figure 2 :Showing distribution of patients in various POG groups

Table 2b : Mean POG in cases and controls

	cases		**control**	
	Mean	SD	Mean	SD
Pog	30.47	4.85	29.32	4.46

Blood pressure recording among cases and control

40 pre eclamptic patents and 15 controls had SBP between 120-160mmhg.35 controls had SBP of less than 120mmhg.only 10 cases had SBP of >160mmhg.(table 3a,fig 3a)

36 cases and 15 controls had DBP between 80 – 90 mmhg.35 controls had DBP<80mmhg. Only 14 patients had DBP>90mmhg. (Table 3b,figure 3b)

The mean SBP of cases were 154.92±13.15 mmhg and of controls were 115.40±6.98 mmhg.The mean DBP of controls were 90.60±5.86 mmhg and of cases were 76.48±4.53 mmhg.(table no. 4)

Table 3a :Showing SBP (in mmHg) among cases and controls

		Cases		Control		Total
		No.	%age	No.	%age	
SBP group	<120	0	0.0%	35	70.0%	35
	120-160	40	80.0%	15	30.0%	55
	>160	10	20.0%	0	0.0%	10
Total		50	100.0%	50	100%	

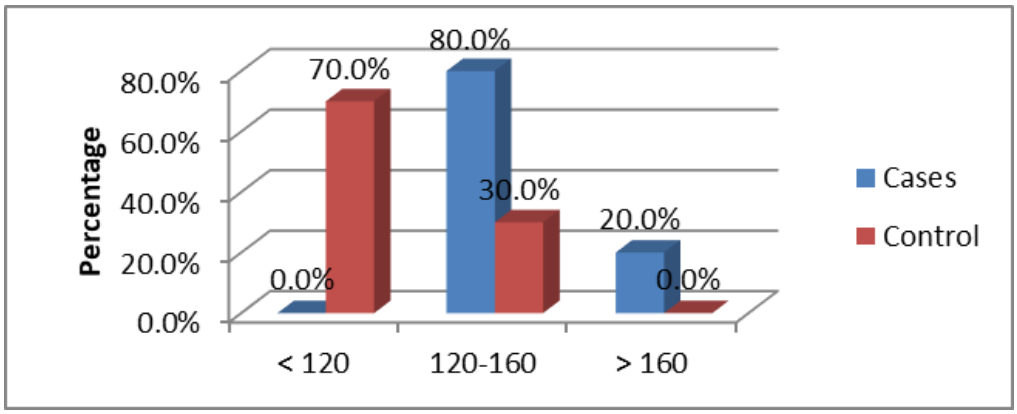

Figure 3a :Showing SBP among cases and controls

Table 3b: showing DBP (in mmHg) among cases and controls

		Cases		Control		Total
		No.	%age	No.	%age	
DBP group	<80	0	0.0%	35	70.0%	35
	80-90	36	72.0%	15	30.0%	51
	>90	14	28.0%	0	0.0%	14
Total		50	100.0%	50	100%	

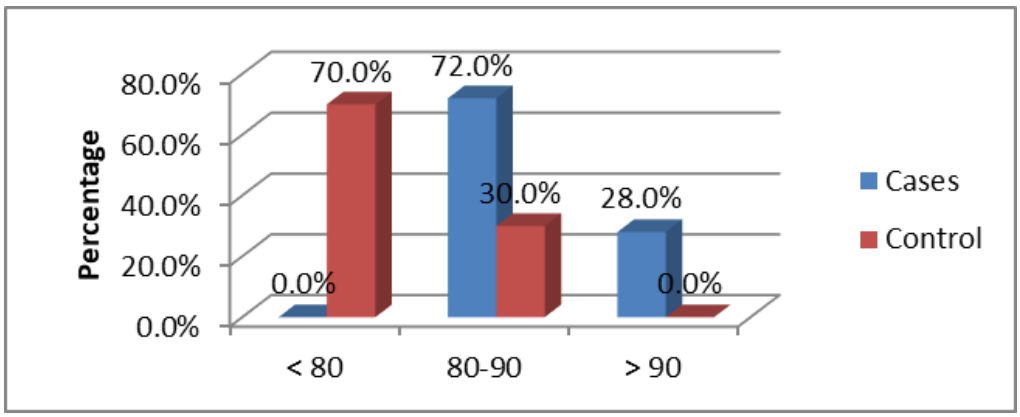

Figure 3b: Showing DBP among cases and controls

Table 4: Showing mean values of SBP and DBP in cases and controls

	cases		controls	
	Mean	**SD**	**Mean**	**SD**
SBP	154.92	13.15	115.40	6.98
DBP	90.60	5.86	76.48	4.53

Symptoms among cases and control

Headache was the most common symptom among the pre eclamptic cases whereas the visual disturbances was the least common.None of the symptoms was shown by normotensive patients.(table 5,figure 4)

Table 5: Showing symptoms among cases and controls

		Cases		**Control**		**Total**
		No.	**%age**	**No.**	**%age**	
Headache	absent	10	20.0%	50	100.0%	60
	present	40	80.0%	0	0.0%	40
Epigastric pain	absent	19	38.0%	50	100%	69
	present	31	62.0%	0	0.0%	31
Visual disturbances	absent	37	74.0%	50	100.0%	87
	present	13	26.0%	0	0.0%	13
Nausea	absent	22	44.0%	50	100.0%	72
	present	28	56.0%	0	0.0%	28
Swelling	absent	27	54.0%	50	100.0%	77
	present	23	46.0%	0	0.0%	23
Total		50	100%	50	100.0%	100

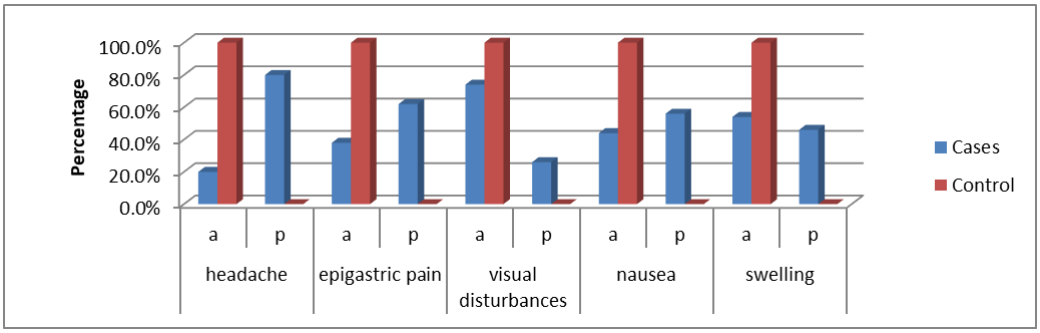

Figure 4: Showing symptoms among cases and controls

Out of 50 cases 10 cases were of urine dipstick 1+ and 2+ each 28 cases had urine proteinuria of 3+ on urine routine and 2 had 4+ .(table no. 6,figure 5)

Table 6: Showing number of patients with grade of proteinuria

		Cases	
		No.	**%age**
Urine dipstick	1+	10	20.0%
	2+	10	20.0%
	3+	28	28.0%
	4+	2	4.0%
Total	50	100.0%	

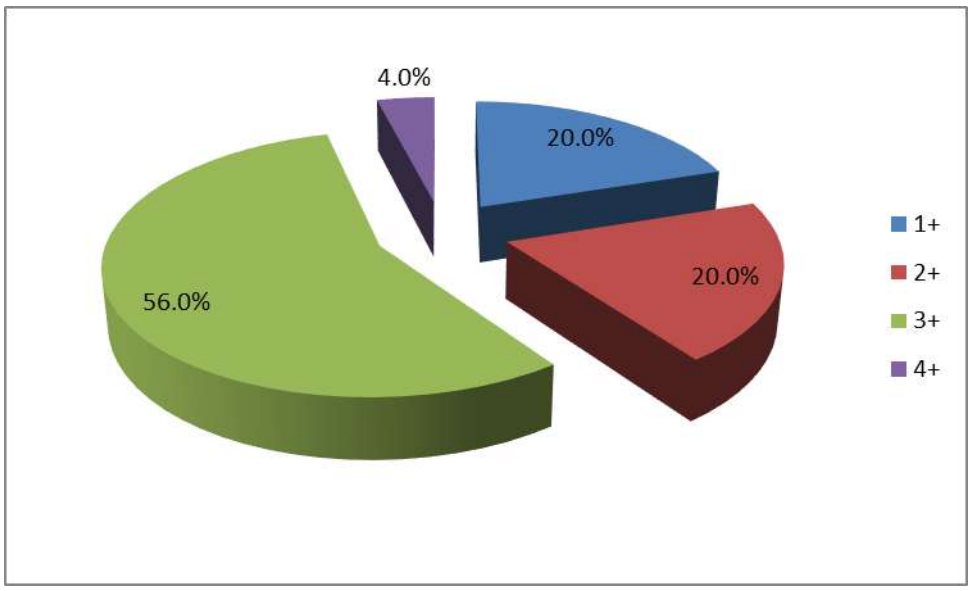

Figure 5: Showing percentage of patients showing grades of proteinuria

Comparison of OAD parameters in normotensive and pre eclamptic patients

The RI and PI mean values were significantly lower in pre eclamptic group than in the controls.the mean value of the peak ratio was also significantly higher in the pre eclamptic patients than in the control group.(table 7 ,figure 6a)

Similarly,PDV was significantly higher in the pre eclamptic patients. The PSV showed no statistical difference between cases and controls.(table 7,figure 6b)

Table 7: Various parameters among cases and controls

		Cases		**control**		**Z**	**p-value**
		Mean	**SD**	**Mean**	**SD**		
	Eye						
PI	Right	1.15	0.29	1.84	0.26	-12.731	0.001
	left	1.20	0.32	1.85	0.26	-11.361	0.001
RI	Right	0.65	0.10	0.81	0.07	-7.879	0.001
	Left	0.65	0.13	0.82	0.09	-7.572	0.001
PR	Right	0.76	0.12	0.50	0.06	13.139	0.001
	Left	0.76	0.13	0.52	0.06	11.995	0.001
PSV	Right	34.57	12.25	31.05	8.69	1.657	0.101
	Left	32.92	9.59	35.81	8.36	-1.610	0.111
PDV	Right	28.59	10.23	16.61	6.47	7.006	0.001
	Left	27.23	8.15	18.98	6.63	5.555	0.001

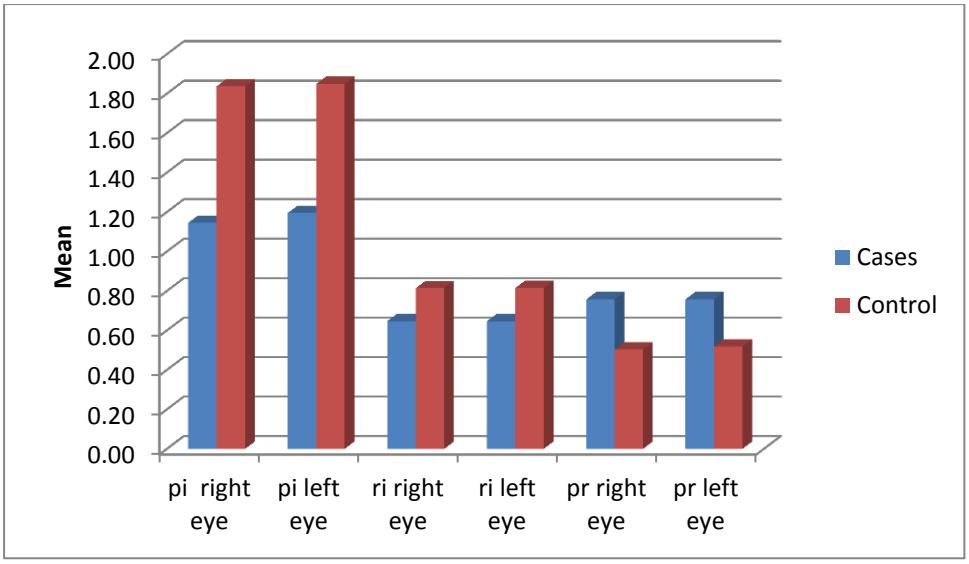

Figure 6a: Showing mean values of PI ,RI ,PR

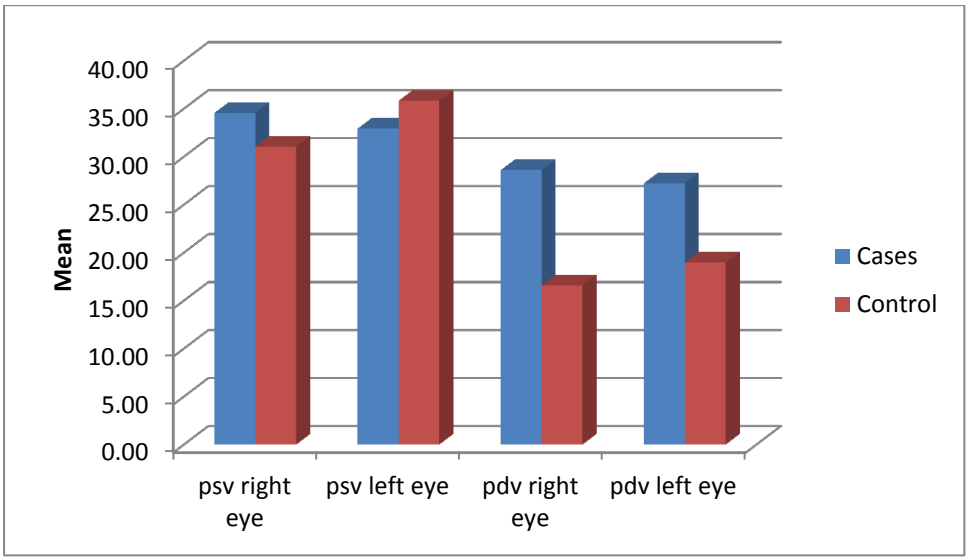

Figure 6b: Showing mean value of PSV and PDV

No. of patients with different grades of pre eclampsia

In total number of cases 34 cases had mild PE and 16 cases had severe PE.(table 8,figure 7)

Table 8: showing number of patients with different grades of pre eclampsia

Pre eclampsia	No. of cases	%age
Mild	34	68.0%
Severe	16	32.0%
Total	50.0	100.0%

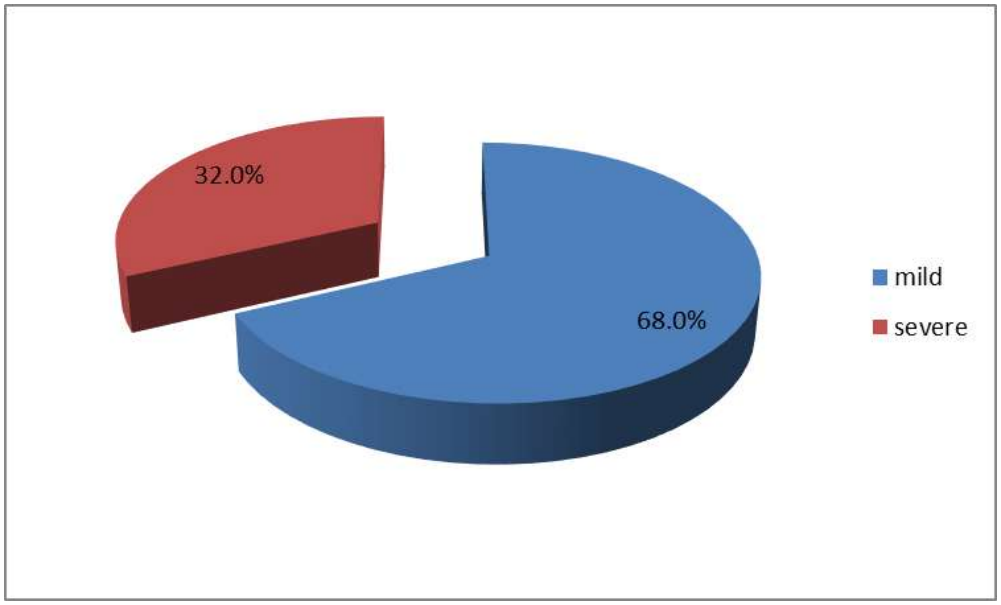

Figure 7: Percentage of patients showing different grades of pre eclampsia

Comparison of OAD parameters between mild and severe pre eclamptics

No variable was found statistically significant to differentiate between mild and severe pre eclampsia.(table 9,figure 8a,8b)

Table 9: Showing various paramteres among mild and severe pre eclampsia

		Mild PE		**Severe PE**		**Z**	**p-value**
		Mean	**SD**	**Mean**	**SD**		
	Eye						
PI	Right	1.13	0.29	1.18	0.28	-0.574	0.569
	left	1.15	0.28	1.29	0.37	-1.519	0.135
RI	Right	0.66	0.12	0.62	0.05	-1.189	0.234
	Left	0.66	0.15	0.62	0.06	-1.177	0.859
PR	Right	0.78	0.11	0.71	0.15	1.715	0.093
	Left	0.78	0.11	0.72	0.15	1.363	0.179
PSV	Right	33.05	12.57	37.81	11.23	-1.290	0.203
	Left	33.11	9.81	32.51	9.41	0.202	0.841
PDV	Right	27.40	10.87	31.13	8.46	-1.206	0.234
	Left	27.57	8.72	26.49	6.98	0.432	0.667

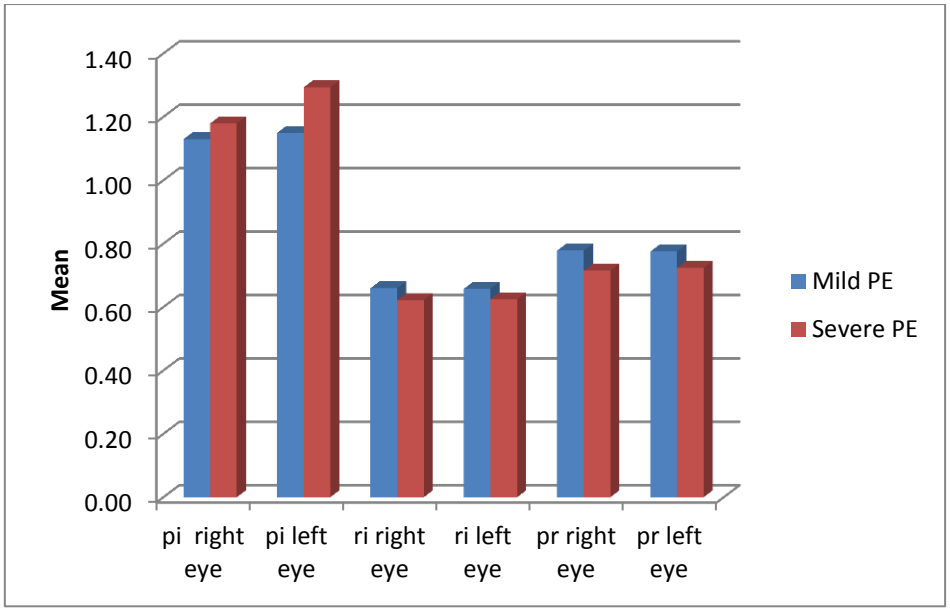

Figure 8a: showing mean value of PI,RI and PR among mild and severe cases of Pre eclampsia

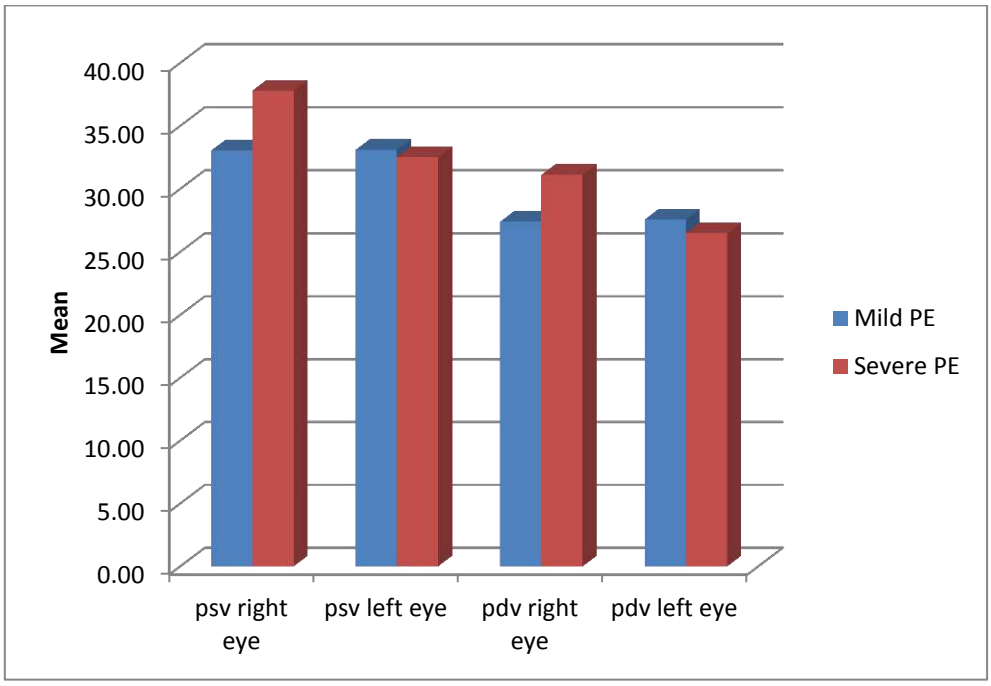

Figure 8b: Showing mean value of PSV and PDV among mild and severe cases of Pre eclampsia

a) Diagnostic Accuracy Of OAD parameters to predict Pre eclampsia

PI , RI and PR are useful to varying extents in predicting a preeclamptic state as determined by Reciever operative characteristic curves(figure 9,10,and 11)

a) PI

PI had a sensitivity of 98 %, specificityof 84% at cut off value of 1.38 with area under the curve 0.954 on right side and sensitivity of 96% and specificity of 86% at cut off value of 1.50 with area under the curve 0.926 on left side.(table 10,figure 9)

Table 10: ROC Curve analysis of PI for prediction of pre-eclampsia

Eye	Area under the curve	Std. error	Asymptotic Sig.	Cut off	Sensitivity	Specificity	Confidence interval	
							Upper Bound	Lower Bound
Right	0.954	0.020	0.000	1.38	98%	84%	0.915	0.994
Left	0.926	0.028	0.000	1.50	96%	86%	0.872	0.981

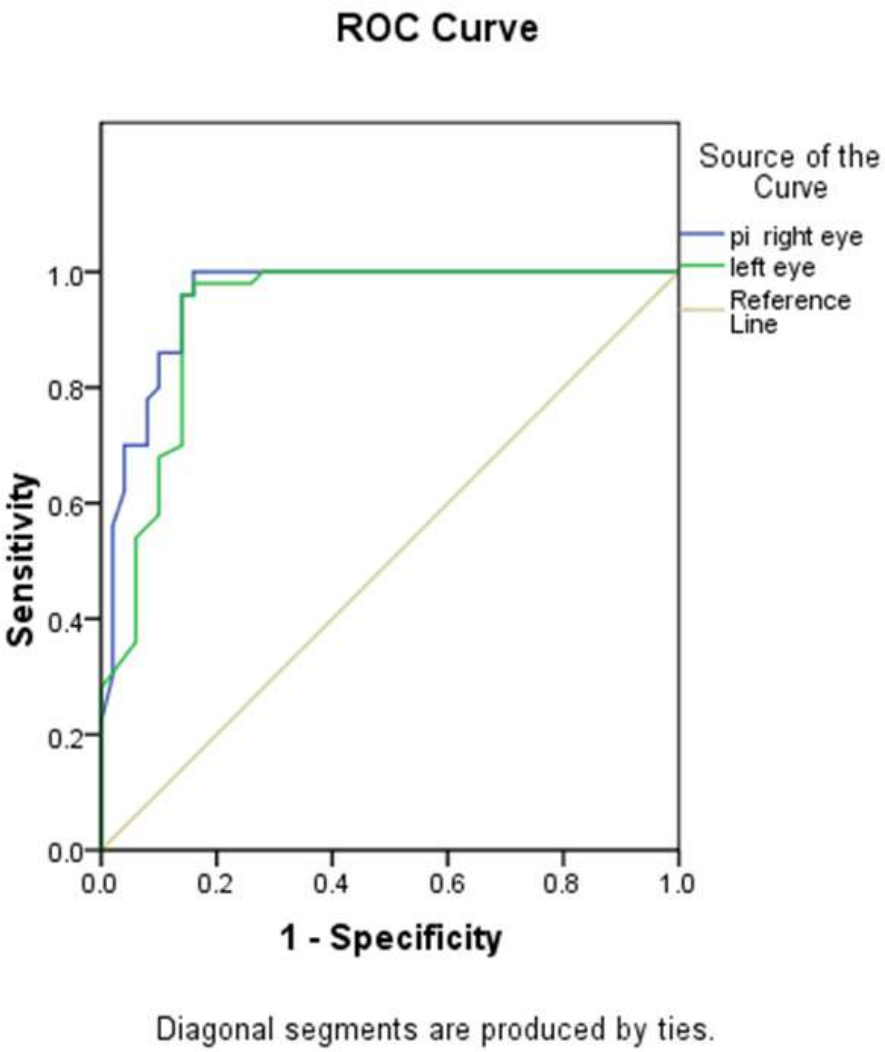

Figure 9: ROC Curve analysis of PI for prediction of pre-eclampsia

b) RI

RI had a sensitivity of 96% , specificity of 92% at cut off value of 0.71 with area under the curve 0.957 on right sideand sensitivity of 94% and specificity of 96% at cut off value of 0.71 with area under the curve 0.939 on left side.(table 11,figure 11)

Table 11: ROC Curve analysis of RI for prediction of pre-eclampsia

Eye	**Area under the curve**	**Std. error**	**Asymptotic Sig.**	**Cut off**	**Sensitivity**	**Specificity**	**Confidence interval**	
							Upper Bound	**Lower Bound**
Right	0.957	0.028	0.001	0.71	96%	92%	0.000	1.000
Left	0.939	0.032	0..001	0.71	94%	96%	0.873	1.000

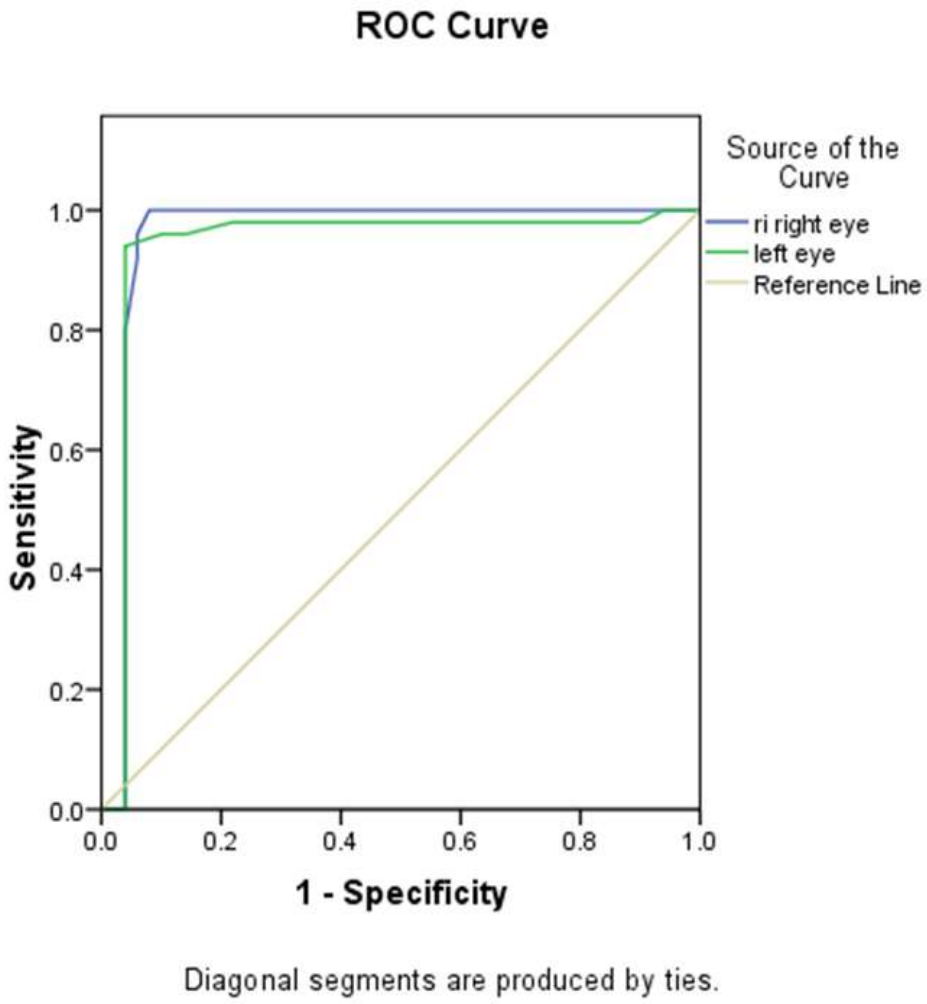

Figure 10: ROC Curve analysis of RI for prediction of pre-eclampsia

c) PR

PR had a sensitivity of 82% ,specificity of 98% at cut off value of 0.60 with area under the curve 0.95 on right side and sensitivity of 76% and specificity of 96% at cut off value of 0.64 with area under the curve 0.92 on left side.(table 12 , figure 12)

Table 12: ROC Curve analysis of PR for prediction of pre-eclampsia

Eye	Area under the curve	Std. error	Asymptotic Sig.	Cut off	Sensitivity	Specificity	Confidence interval	
							Upper Bound	Lower Bound
Right	0.94	0.022	0.000	0.60	82%	98%	0.897	0.985
Left	0.92	0.026	0.000	0.64	76%	96%	0.874	0.975

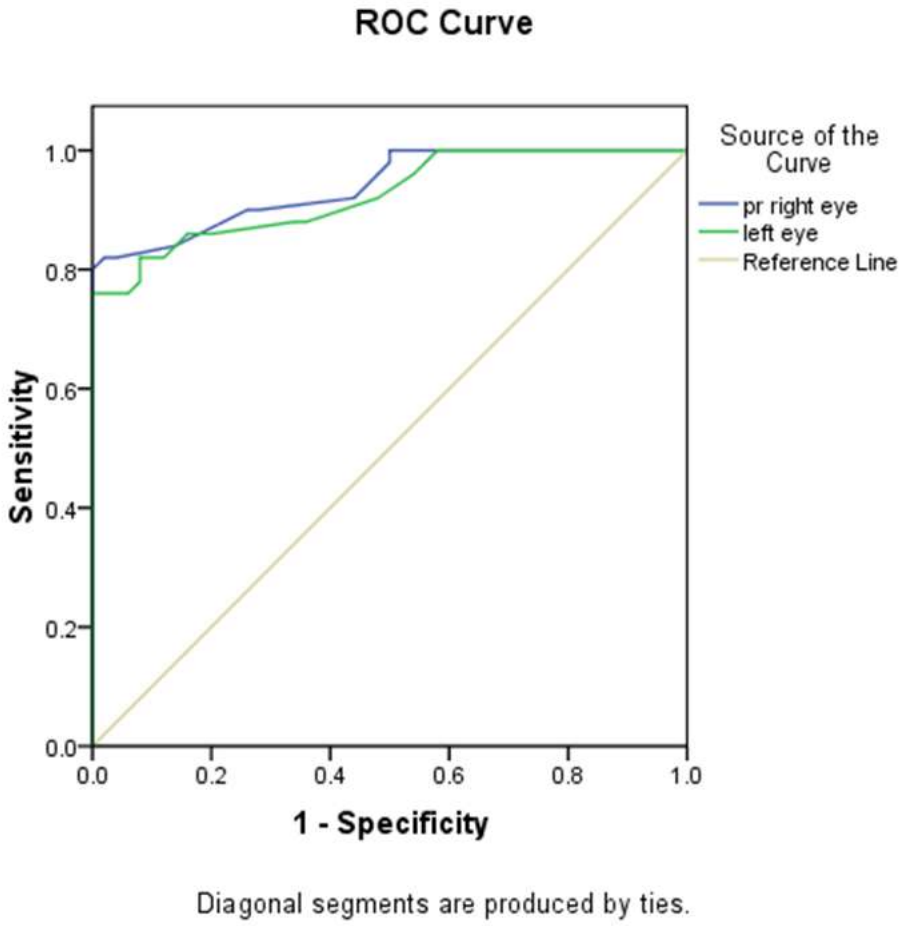

Figure 11: ROC Curve analysis of PR for prediction of pre-eclampsia

DISCUSSION

Pre eclampsia is a major cause of maternal mortality and morbidity. Early identification of females at risk of development of Pre eclampsia helps in timely interventions which can reduce the maternal and perinatal morbidity.

Traditionally, various clinical parameters had been used to predict the development of preeclampsia.

As clinical markers are not sensitive for identification of Pre eclampsia. So, Many current studies now focus on identification of various new predictive markers which can help to diagnose Pre eclampsia at an early gestation.

So transorbital Ophthalmic artery Doppler can be used as a predictive marker to detect perfusion changes in ophthalmic artery in case of pre eclampsia. It is readily available and cost effective and can serve as potential marker for early detection of pre eclampsia especially in resource constraint countries.

Our study evaluated various OAD parameters which include PI, RI, PDV, PSV and PR in patients with pre eclampsia and compared it with normotensive patients .The results were found reassuring.

In our study PI value of Pre eclamptic patients in right eye was 1.06±0.18and in left eye was 1.11±0.19 which was significantly (p value= 0.001) lower than normotensive females which was 1.84±0.26 and 1.85±0.26 in right and left eye respectively. This was found in concordance to the study done by Olatunji et al ,They have measured PI values 1.20±0.50 in right eye and 1.34±0.34in left eye and which was significantly(p = 0.00) lower than controls which has mean value of 1.60±0.40 and 1.52±0.48 in right and left eye respectively in controls.[48]

E Selima et al has also done a prospective study on 120 pregnant females and found a PI of 1.68 ± 0.18 in mild pre eclampsia and 1.48 ± 0.13 in severe pre eclampsia which was significantly(p=0.001) lower than controls with mean value of 2.07±0.36. [38]

Similarly, Onwudiegwu et al has given PI values 0.70±0.18 in cases and 0.83 /0.27 in controls which was significantly lower with p value <0.001 .[42] In the study done by T Ayaz et al .also found the PI values were 0.91±0.10 in pre eclamptic patients which was significantly lower than controls with mean value of 1.78±0.20 and p value of 0.0001.[28]

In our study RI values were .65 ±0.10 in right and 0.65±0.13 in left eye and found to be significantly lower in normotensive females which has mean value of 0.81±0.07 in right and 0.82±0.09 in left eye with p value of 0.001.Our findings were consistent with study done by Olatunji et al ,they found RI values in right eye 0.62±0.10 and in left eye 0.63±0.83 in cases which was significantly(p=0.00) lower in controls and measures 0.70±10 in right and 0.70±0.08 in right and left eye respectively.[48] Onwudiegwu et al has found RI of 0.70±0.18 in pre eclamptic patients and 0.83±0.27 in controls which was significantly lower with p value of 0.001.[42]

Similarly, T Ayaz et al found that RI in pre eclamptic patients was 0.57 ±0.04 which was significantly(p value=0.001)lower than controls with mean value of 0.78±0.03.[28]

Oliviera et al has also found mean value of 0.682±0.028 in cases which was significantly lower than controls with mean value of 0.700±0.029 and p value of p value of 0.044.[50]

E selima et al has found that RI in controls is 0.79±0.03 whereas in mild pre eclamptic cases 0.73±0.03 and severe cases 0.74±0.03 which was significantly lower with p value of 0.001[38]

In Our study PR values were 0.82±0.06 in right and 0.83±0.05 in left eye in pre eclamptic patients and found to be significantly(p value 0.001) higher than normotensive patients which was 0.50±0.06 and 0.52±0.06 in right and left eye. These findings were consistent with study done by E Selima et al that has found PR in mild pre eclamptic cases was 0.69±0.07 and in severe cases it was 0.69±0.03 which was significantly (p value = 0.001)higher than controls which has PR of 0.50 ±0.09.[38]

Onwudiegwu has also noted the PR value for controls 3.3±0.9 and in cases these were 6.0±1.1 which was significantly higher than the controls with p value of<0.001.[42]

Similarly, D S matias has found that PR value for the Cases was 0.57±0.11 which was significantly higher with p value o 0.001 than controls which showed mean value of 0.51±0.12 [49]

Our study showed that PDV was significantly (p value= 0.001) higher in pre eclamptic patients with mean value of 28.59±10.23 cm/s in right eye and 27.23±8.15 cm/s in left eye whereas it was 16.61±6.47 cm/s in right and 18.98±6.63cm/s in left eye. These findings were in concordance with the study done by Olatunji et al which also showed that mean values were significantly higher in pre eclamptics with mean value measuring 22.56±7.13cm/s in right eye and 25.83±8.73cm/s in left eye whereas it was 19.06±6.82cm/s in right and 19.85±7.34cm/s in left eye in controls [48]

Our study did not find any significant difference between PSV of pre eclamptic patients with mean value of 34.57 ±12.25 cm/s in right eye and 32.92±9.59cm/s in left eye and normotensive patients with mean value of 31.05 ±8.69cm/s in right eye and 35.81±8.36cm/s in left eye.

The observations in our study as regards the trend of PSV in normotensive and pre-eclamptic patients are at variance with reports in the literature.[25,35,51,52]

Our findings are consistent with study done by Olatunji et al that also showed no statistical significance with p value of 0.11 of PSV in both eyes measuring 28.16±9.15cm/s in right eye in cases and 32±12.30cm/s in controls in right eye,29.77±10.69 cm/s in left eye in cases and 33.88±12.22cm/s in left eye in controls.[48]

The smaller sample size used in most of these previous studies with discordant results coupled with differences in the study population, instruments, and sonographic techniques used may be partly responsible for the variation in findings.

In our study no variable was statistically significant to assess the degree of pre eclampsia. The reason behind it may be the small sample size. Other reason for it can be that many of the patients were on antihypertensive drugs.

In our study PI had sensitivity of 98%, specificity of 84% at cut off of 1.38 on right side and sensitivity of 96% and specificity of 86% at cut off of 1.50 on left side to detect pre eclampsia. This is concordant with the study done by E. Selima et al ,they found sensitivity of 89.7%, specificity of 75.12% at cut off <1.76.[38]

In our study ,RI had sensitivity of 96% and specificity of 92% at cut off value of 0.71 on right side and sensitivity of 94% ,specificity of 96% at cut off value of 0.71 in left eye. This is consistent with the study done by E Selima et al, they found sensitivity of 80.2%, specificity of 74.9% at cut off value <0.77.(42) Olatunji et al have also found sensitivity of 75% and specificity of 77.8% at cut off value off 0.61 in prediction of pre eclampsia.[48]

In our study, PR had sensitivity of 82%,specificity of 98% at cut off value of 0.60 on right side and sensitivity of 76% ,specificity of 96% at cut off value of 0.64on left side. This is consistent with the study done by Olatunji et al they found sensitivity of 90.5%,specificity of 81.3% at cut off value 0.72. (52)E Selima et al has also found sensitivity of 77.3% , specificity of 65.8% at cut off value of 0.59.[38]

The identification of women at low risk or high risk for developing PE with help of derived cut off values may have clinical benefits especially in rural or peripheral centres. It may help to improve the care of pregnant women by adopting conservative management in low risk category and timely intervention in high risk category. Thus enhancing the better pregnancy outcome for mother and child.

Also the cut off values will help in encouraging intensive care of high risk patient and thus reducing the maternal mortality which is currently a big challenge in developing countries.

Future studies are warranted in different populations and in different clinical settings/pharmacological therapy to ascertain how well OAD parameters can predict complications in preeclampsia thus affecting the pregnancy outcomes

LIMITATIONS

Although data from our study is encouraging, but the study included a small number of patients, especially patients of severe pre eclampsia. Study with a large sample size and patients of severe pre eclampsia can help to assess the hemodynamic changes in mild and severe preeclampsia in a better way.

Another limitation can be that OAD is a operator dependent modality. At times it can be time consuming because of continuous eye motion by the patient.

CONCLUSION AND SUMMARY

Our study shows that Resistivity and Pulsatility Index decreases whereas Peak ratio increases in pre eclamptic patients than normotensive patients. Decrease in Resistivity and pulsatility index supports the hypererfusion model of central hemodynamics in pre eclamptic patients. Peak Diastolic Velocity also found to be significantly increased in pre eclamptic patients than normotensive females.

PI showed maximum sensitivity whereas Peak Ratio showed maximum specificity in prediction of pre eclampsia.

We can conclude that OAD is a safe, cheap ,non invasive and readily available method for evaluation of intracranial flow changes pre eclamptic patients. So, It can be incorporated into the routine evaluation of pregnant females who are at high risk to develop pre eclampsia for early detection of progression to severe form before cerebral complications develop.

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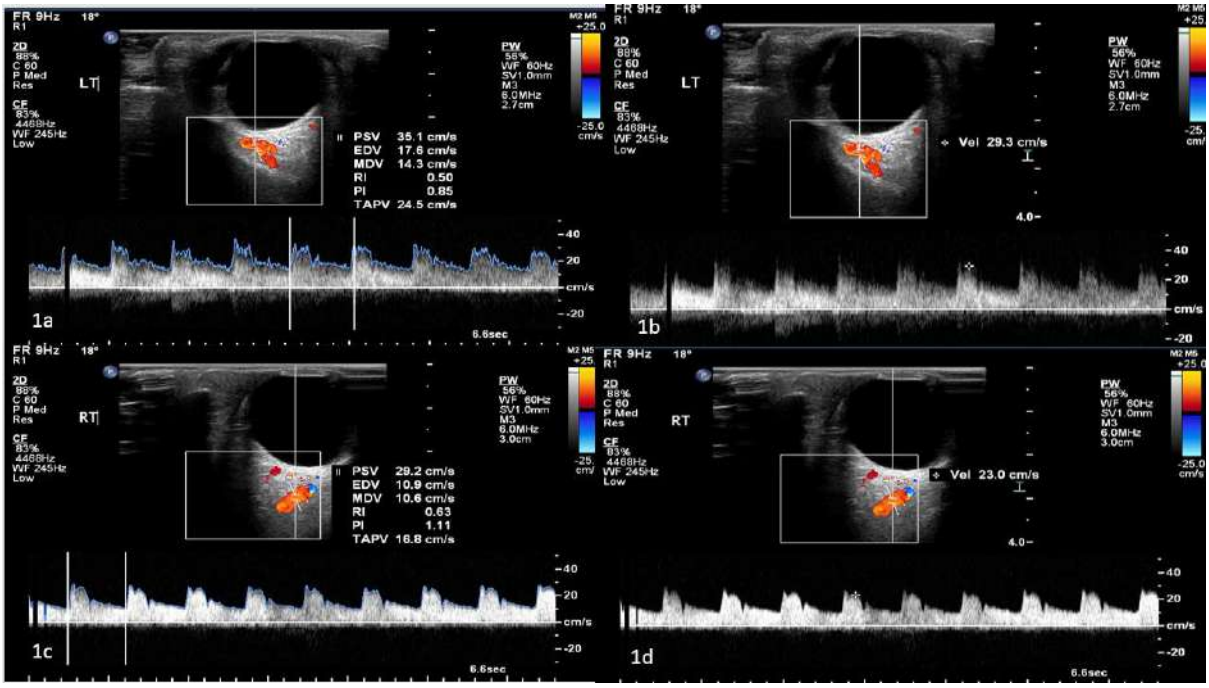
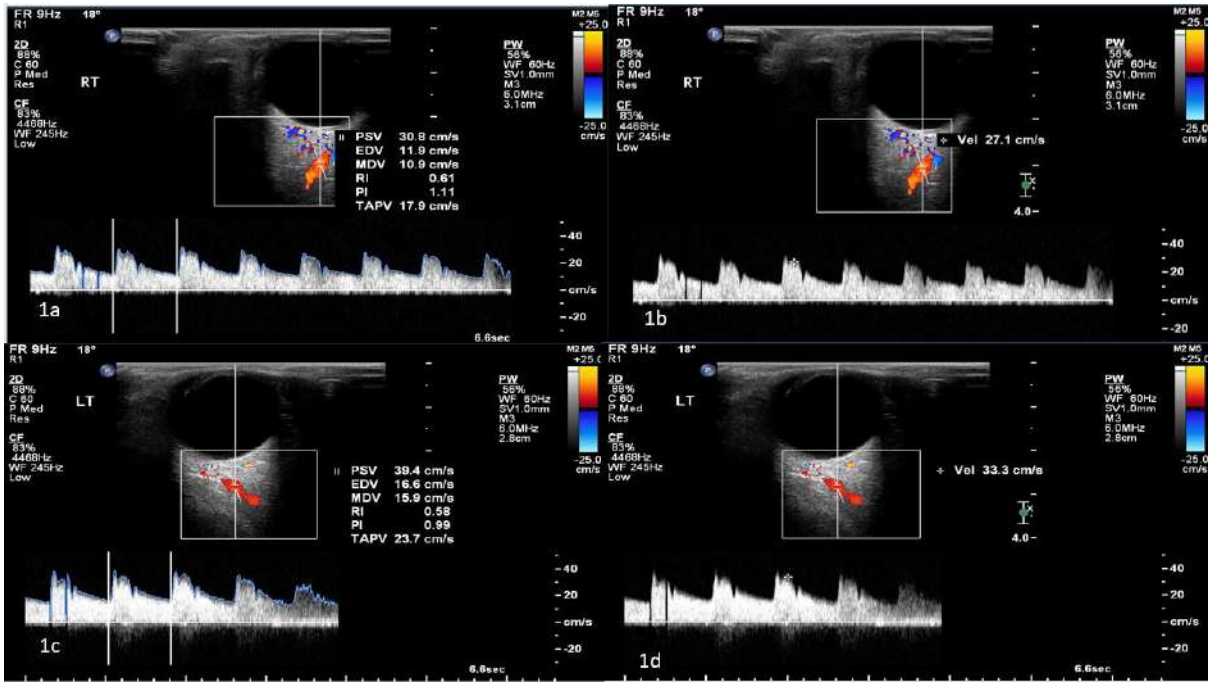
Case 1



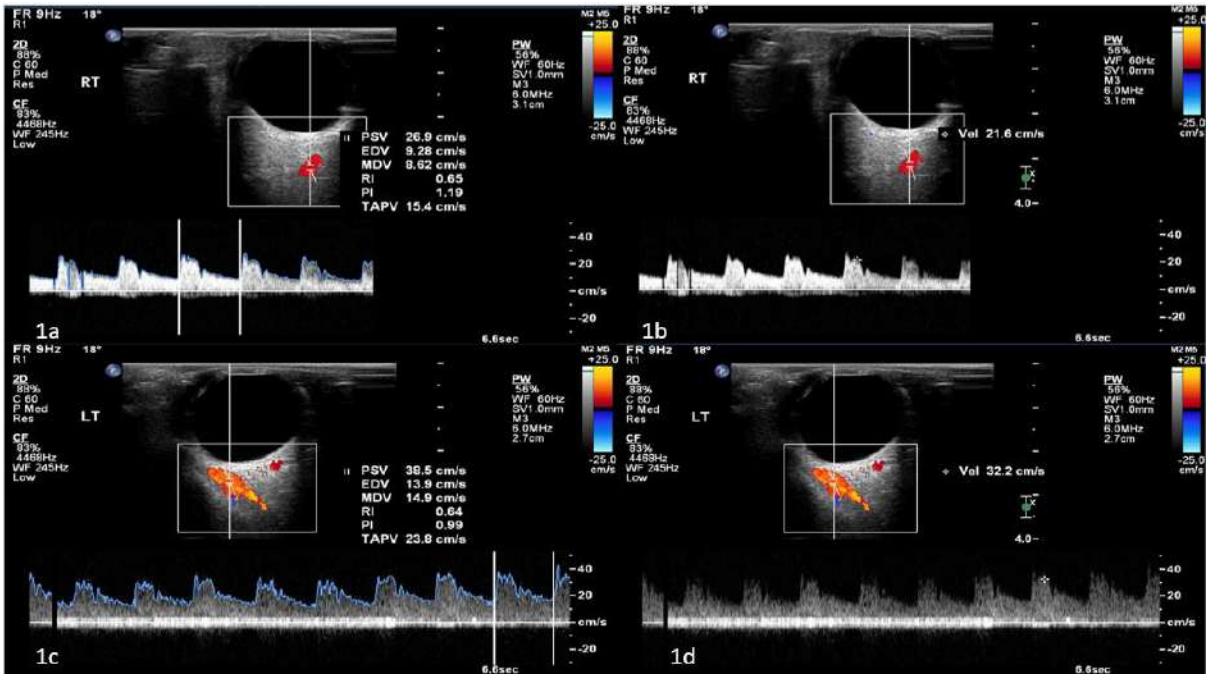
PICTURE 1: Ophthalmic artery doppler shows a) PSV(peak systolic velocity) of 35.1 cm/s , RI(resistivity index) of 0.50 and PI (pulsatility index) of 0.85 in right ophthalmic artery b)PDV(peak diastolic velocity) of 29.3 cm/s in right ophthalmic artery c) PSV(peak systolic velocity) of 29.2cm/s, RI(resistivity index) of 0.63 and PI (pulsatility index) of 1.11 in left ophthalmic artery d) peak diastolic velocity of 23.0 cm/s in left ophthalmic artery

Case 2



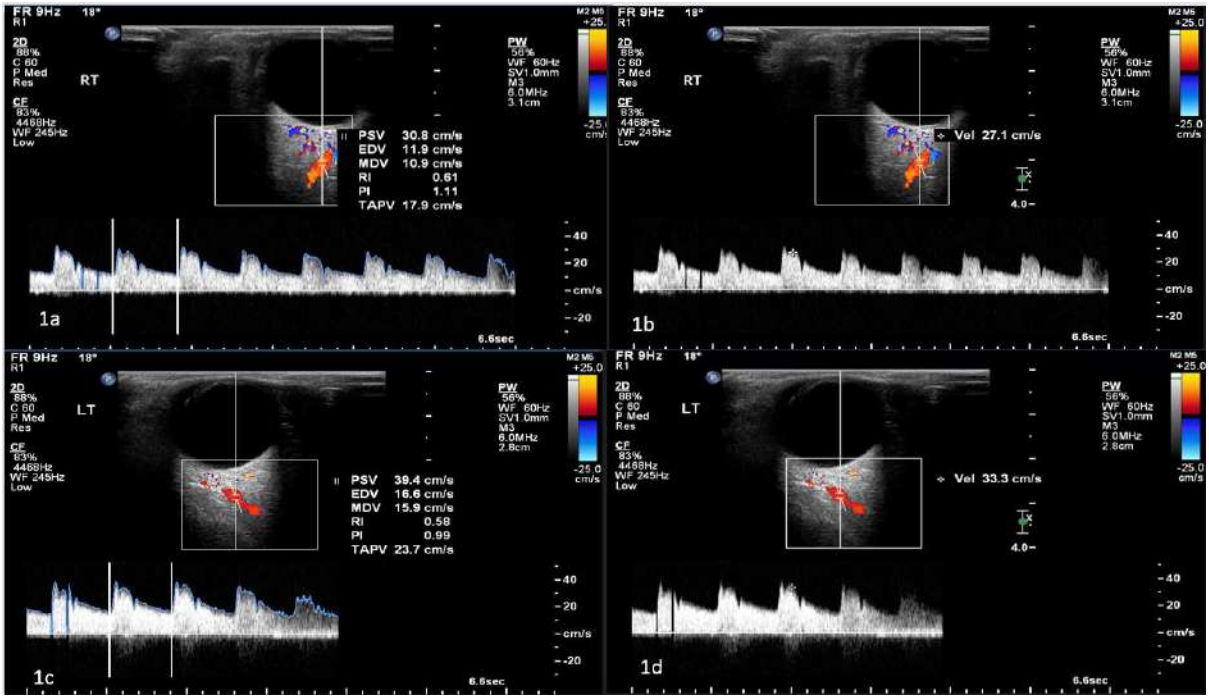
PICTURE 2: Ophthalmic artery doppler shows a)PSV(peak systolic velocity) of 30.8cm/s, RI(resistivity index) of 0.61 and PI (pulsatility index) of 1.11 in right ophthalmic artery b)PDV(peak diastolic velocity) of 27.1 cm/s in right ophthalmic artery c) PSV(peak systolic velocity) of 39.4cm/s, RI(resistivity index) of 0.58 and PI (pulsatility index) of 0.99 in left ophthalmic artery d)PDV(peak diastolic velocity) of 33.3 cm/s in left ophthalmic artery

Case 3



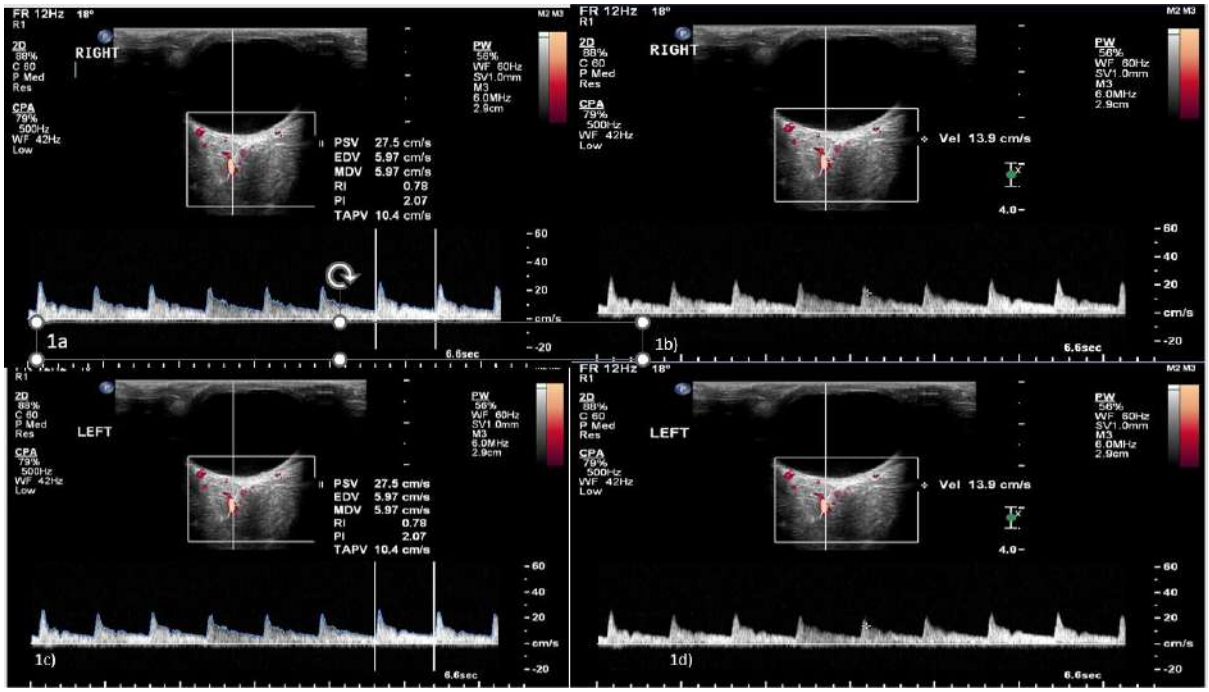
PICTURE 3: Ophthalmic artery doppler shows a) PSV(peak systolic velocity) of 26.9 cm/s, RI(resistivity index) of 0.65 and PI (pulsatility index) of 1.19 in right ophthalmic artery b)PDV (peak diastolic velocity) of 21.6 cm/s in right ophthalmic artery c) PSV(peak systolic velocity) of 38.5 cm/s ,RI(resistivity index) of 0.64 and PI (pulsatility index) of 0.99 in left ophthalmic artery d)PDV (peak diastolic velocity) of 32.2 cm/s in left ophthalmic artery

Case 4



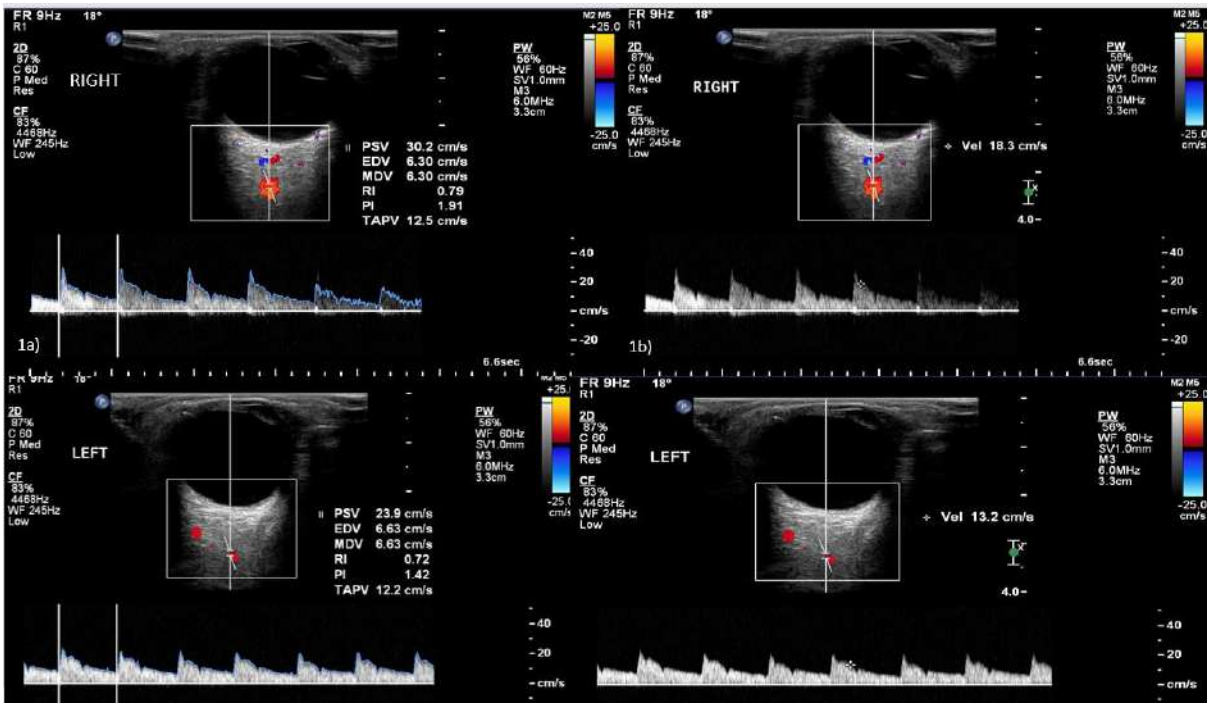
PICTURE 4: Ophthalmic artery doppler shows a) PSV(peak systolic velocity) of 30.8 cm/s, RI(resistivity index) of 0.61 and PI (pulsatility index) of 1.11 in right ophthalmic artery b)PDV (peak diastolic velocity) of 27.1 cm/s in right ophthalmic artery c) PSV(peak systolic velocity) of 39.4cm/s RI(resistivity index) of 0.58 and PI (pulsatility index) of 2.07 in left ophthalmic artery d)PDV (peak diastolic velocity) of 33.3cm/s in left ophthalmic artery

Control 1



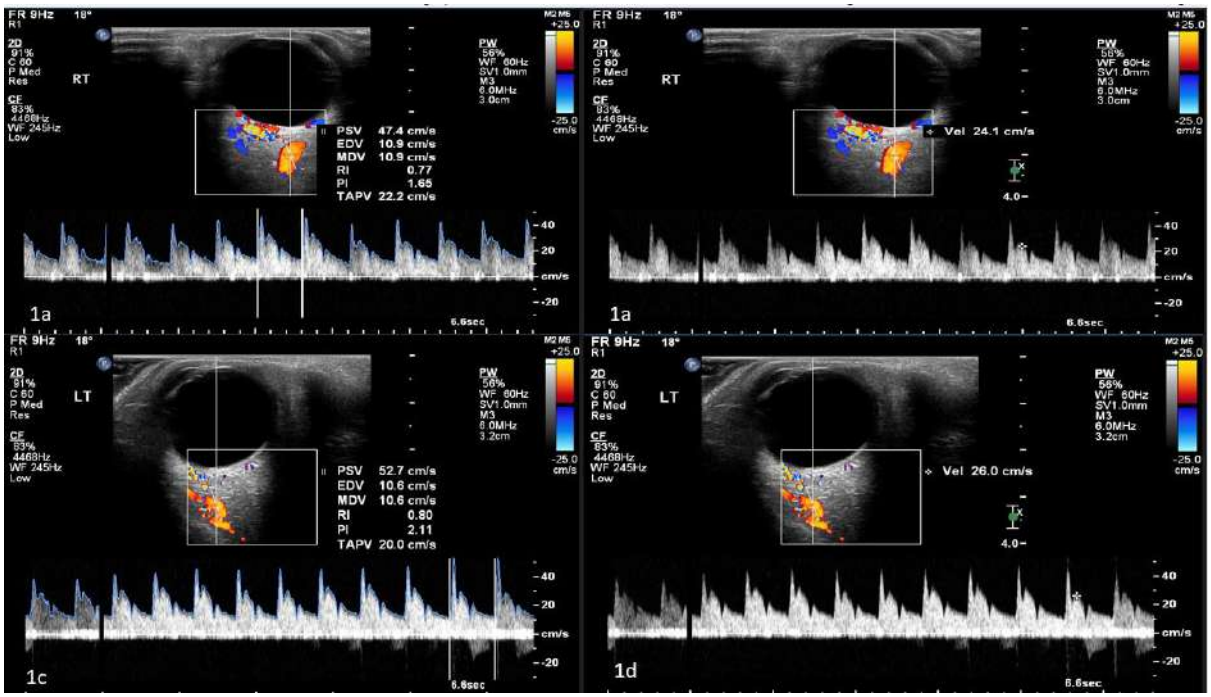
PICTURE 5: Ophthalmic artery doppler shows a) PSV(peak systolic velocity) of 27.5 cm/s, RI(resistivity index) of 0.78 and PI (pulsatility index) of 2.07 in right ophthalmic artery b)PDV(peak diastolic velocity) of 13.9 cm/s in right ophthslmic artery c) PSV(peak systolic velocity) of 27.5cm/s ,RI(resistivity index) of 0.78 and PI (pulsatility index) of 2.07 in left ophthalmic artery d)PDV(peak diastolic velocity)of 13.9 cm/s in left ophthalmic artery

Control 2



PICTURE 6: Ophthalmic artery doppler shows a) PSV(peak systolic velocity) of 30.2 cm/s, RI(resistivity index) of 0.79 and PI (pulsatility index) of 1.91 in right ophthalmic artery b)PDV(peak diastolic velocity) of 18.3 cm/s in right ophthalmic artery c) PSV(peak systolic velocity) of 23.9 cm/s RI(resistivity index) of 0.72 and PI (pulsatility index) of 1.42 in left ophthalmic artery d)PDV(peak diastolic velocity)of 13.2cm/s in left ophthalmic artery

Control 3



PICTURE 7: Ophthalmic artery doppler shows a) PSV(peak systolic velocity) of 47.4 cm/s, RI(resistivity index) of 0.77 and PI (pulsatility index) of 1.65 in right ophthalmic artery b)PDV(peak diastolic velocity) of 24.1 cm/s c) PSV(peak systolic velocity) of 52.7 cm/s , RI(resistivity index) of 0.80, and PI (pulsatility index) of 2.11 in left ophthalmic artery d)PDV(peak diastolic velocity) of 26.0 cm/s in left ophthalmic artery

PROFORMA

S.no

SECTION A : BIO-DATA AND VITALS

Name of the patient -

Age: -

MRD Number: -

Husbands Name: -

Address:

Age at marriage: Married for:

VITALS:

Blood Pressure: Pulse Rate

SECTION B : PAST OBSTETRIC HISTORY

Obstetric formula:(GPALS)

Obstetric history(In brief):

SECTION C : CURRENT PREGNANCY

LMP: POG: EDOD:

Family History of Hypertension:

Socio-economic status:

Method of Conception: Natural/ Artificial Reproductive Technique

Presenting Complaints:

Headache:

Epigastric Pain:

Visual disturbances:

Nausea:

Swelling of hands and face:

Signature of Candidate **Signature of Supervisor**

Antenatal History

First Trimester	Second Trimester	Third Trimester

Provisional/Clinical Diagnosis :

SECTION D : INVESTIGATIONS

INVESTIGATION	RESULTS
TLC	
DLC	
Hb	
Platelets/PTI-INR	
Bilirubin(T/D)	
SGOT/SGPT/LDH	
Blood Urea	
S. Creatinine	
Urine Complete Examination	

Other Investigations:

Interpretation:

Signature of Candidate

Signature of Supervisor

SECTION E : COLOR DOPPLER STUDIES

Date:

OPHTHALAMIC ARTERY PARAMETERS:

PARAMETERS:	RIGHT EYE	LEFT EYE
PSV :		
PDV :		
RI :		
PI :		
PR :		

DOPPLER INTERPRETATION:

SECTION F: CONCLUSION FOR THE CASE

Signature of Candidate

Signature of Supervisor

KEY TO MASTER CHART

PI – Pulsatility index

RI – Resistivity index

PSV – Peak systolic velocity

PDV – Peak diastolic velocity

SBP – Systolic blood pressure

DBP – Diastolic blood pressure

POG – Period of Gestation

SGOT – Serum glutamic-oxaloacetic transaminase

SGPT – Serum glutamic pyruvic transaminase

LDH – lactate dehydrogenase

S. No.	MRD Number	Name	pi right eye	pi left eye	ri right eye	ri left eye	pr right eye	pr left eye	psv right eye
1	1171311	p	1.5	1.8	0.64	0.64	0.62	0.58	31.2
2	1181736	kp	1.6	1.7	0.61	0.62	0.58	0.6	36.1
3	1179392	bk	1.7	1.8	0.65	0.66	0.91	0.94	20.4
4	1191785	as	1.5	1.9	0.59	0.6	0.56	0.54	30.8
5	27766	kk	1.8	1.7	0.66	0.69	0.52	0.56	20.6
6	1200280	rb	1.7	1.9	0.66	0.64	0.54	0.52	28.8
7	1184052	nk	2	1.9	0.67	0.6	0.56	0.58	33.8
8	40435	s	1.25	1.48	0.68	0.69	0.51	0.54	28.8
9	1241651	jk	0.75	1.01	0.53	0.61	0.52	0.51	30.2
10	1237185	sj	1.02	1.2	0.59	0.66	0.52	0.5	25.2
11	1022160	gk	1.22	1.07	0.65	0.63	0.8	0.79	34.1
12	1042214	br	1.04	1.3	0.59	0.69	0.91	0.79	24.5
13	1130893	sk	1.15	1.15	0.62	0.65	0.77	0.78	34.8
14	129584	g	0.98	0.95	0.64	0.67	0.92	0.85	45.7
15	1212024	pl	1.14	1.11	0.65	0.63	0.81	0.81	46
16	1163415	hk	1.19	1.14	0.6	0.67	0.71	0.62	63.3
17	1163442	gv	0.8	1.2	0.5	0.6	0.78	0.78	15.1
18	32773	m	0.66	1.1	1.05	0.66	0.86	0.86	27.6
19	1158397	pk	0.72	1.1	0.51	0.6	0.95	0.9	21.5
20	1064898	mk	1.12	1.02	0.6	0.62	0.79	0.75	42.5
21	1213331	ag	1.1	1.08	0.62	0.64	0.56	0.52	33.6
22	476649	r	1.28	1.39	0.68	0.61	0.88	0.84	13.6
23	1394439	sk	1.2	0.69	0.69	1.3	0.68	0.69	29.5
24	1395167	pt	0.63	0.65	1.07	1.13	0.6	0.61	21.2
25	1364907	nk	0.73	1.22	0.52	0.68	0.66	0.96	38.5
26	1387814	kg	1.04	1.01	0.66	0.64	0.8	0.81	21.2
27	1394484	pk	1.22	1.18	0.68	0.57	0.77	0.82	30.9
28	1395190	hk	0.9	0.9	0.58	0.59	0.8	0.77	29
29	417133	mr	0.79	0.59	0.52	0.44	0.88	0.83	28
30	1063027	ak	1.3	1.22	0.74	0.68	0.83	0.72	31
31	1326936	kk	1.17	1.18	0.68	0.66	0.8	0.79	32.8
32	1392254	p	1.22	1.05	0.66	0.63	0.73	0.75	65.6
33	1395630	nk	1.1	1.05	0.69	0.66	0.78	0.79	31
34	213934	hk	1.18	1.32	0.64	0.66	0.79	0.75	26.2
35	1323743	jk	1.08	1.36	0.62	0.67	0.79	0.8	30.5
36	1341850	hk	1.09	1.14	0.65	0.6	0.8	0.8	42.1
37	1382086	jk	1.14	1.18	0.66	0.67	0.78	0.83	33.5
38	1395369	pk	1.15	1.33	0.64	0.64	0.8	0.81	31.2
39	1220707	mr	1.14	1.27	0.69	0.58	0.86	0.83	32.1
40	1394492	a	1.15	1.15	0.62	0.65	0.75	0.78	35.8
41	1396129	mk	1.14	1.18	0.68	0.63	0.84	0.9	48.7
42	1393741	sk	1.14	1.19	0.67	0.65	0.89	0.88	63.3
43	1396284	mk	1.16	1.1	0.62	0.64	0.9	0.88	33.5
44	1220641	pkd	0.87	1.06	0.57	0.61	0.78	0.82	32
45	1396129	mk	1.4	1.2	0.7	0.6	0.82	0.84	31
46	1144775	jk	1.12	1.11	0.67	0.57	0.89	0.89	37
47	471092	ak	1	0.99	0.64	0.58	0.88	0.89	58
48	1290704	nk	0.9	0.67	0.58	0.46	0.78	0.88	59
49	407897	j	0.9	0.59	0.58	0.44	0.8	0.84	59
50	1397514	jk	1.19	1.18	0.66	0.64	0.82	0.8	28.8
51	1326120	ps	2.22	2.74	0.81	0.79	0.47	0.52	20.9
52	1130517	kk	2.3	2.1	0.84	0.82	0.43	0.45	42.3
53	1084310	sb	1.68	1.58	0.74	0.69	0.47	0.49	35.5
54	1286536	hk	2	1.75	0.79	0.74	0.44	0.49	34.8
55	1398244	r	2.1	2.06	0.78	0.79	0.55	0.45	47.1
56	955530	rk	2.05	1.59	0.79	0.73	0.45	0.46	33.5
57	1356310	mk	1.81	1.7	0.76	0.75	0.59	0.42	40.8

S. No.	psv left eye	pdv right eye	pdv left eye	age	SBP	DBP	pog	Headache	epigastric pain	visual disturbance
1	25.5	25.5	29.8	23	164	88	24.2	Present	Present	Absent
2	33.5	28.2	29.6	33	170	96	26.5	Present	Absent	Absent
3	24.1	18.6	22.7	36	158	90	31.1	Present	Absent	Absent
4	28.8	28.5	26.3	27	170	96	20.4	Present	Present	Absent
5	39.1	17.2	33.7	28	160	80	20.5	Present	Absent	Absent
6	29.5	23.8	23	27	160	100	28.4	Present	Absent	Absent
7	29.2	23.4	24.5	32	160	90	33.3	Present	Absent	Absent
8	19.6	24.5	16.1	29	140	100	28.5	Present	Present	Absent
9	24.5	24.1	19	32	160	100	31.1	Present	Present	Present
10	31	20.8	24.5	33	146	90	32.6	Present	Present	Absent
11	21.2	27.4	16.8	39	160	90	31.4	Present	Present	Absent
12	20.2	22.3	16.1	35	162	90	35.4	Present	Present	Absent
13	33.5	27.1	26.3	21	170	110	39	Present	Present	Present
14	28.8	42.1	24.5	34	160	96	24.4	Present	Absent	Absent
15	30	41	26	26	220	110	33	Present	Present	Present
16	52.7	56	47.2	44	160	90	22.5	Absent	Present	Present
17	29.7	11.8	23.4	33	142	86	36.1	Present	Absent	Absent
18	27.4	24	23.8	36	146	90	35.2	Present	Present	Absent
19	25.5	20.5	20.3	35	146	86	30.1	Present	Present	Absent
20	47.2	33.6	35.8	32	154	86	31.2	Present	Present	Absent
21	34.5	30	32.2	27	150	90	30.3	Present	Present	Absent
22	15.2	12.1	12.8	27	160	90	33	Present	Present	Absent
23	27.5	24.1	22	26	148	90	33.6	Present	Present	Absent
24	36.5	16.8	28.9	33	140	90	36.2	Present	Absent	Absent
25	29.2	30.4	25.6	24	148	96	27.4	Absent	Absent	Absent
26	36.5	16.8	28.9	27	148	84	24.5	Present	Present	Absent
27	25.5	24.1	21	31	144	86	23.4	Absent	Present	Present
28	24	23	20	32	158	84	34.2	Absent	Absent	Present
29	23	22	19	34	154	88	32.4	Present	Present	Absent
30	32	25	26	21	158	90	34.3	Absent	Present	Absent
31	33.1	26.3	26.3	22	142	86	28.3	Present	Present	Absent
32	49.4	47.2	37.3	36	162	92	36.3	Absent	Absent	Present
33	32.1	25.3	26	34	142	84	22.3	Absent	Absent	Present
34	31.2	19.8	24.9	32	144	88	34.3	Present	Present	Absent
35	25.9	24.5	20.5	32	148	88	21.3	Present	Present	Absent
36	30.8	34.4	24.9	28	146	88	32.4	Present	Absent	Absent
37	51	27.8	39	26	140	90	32.2	Present	Present	Absent
38	25.5	25.2	20.8	36	146	90	36.2	Present	Absent	Absent
39	38.5	27.4	27.1	27	178	94	32.4	Absent	Absent	Present
40	33.5	26.3	26.3	29	162	96	24.1	Absent	Absent	Present
41	37.8	44.3	31.8	27	142	86	32.5	Present	Present	Present
42	52.7	56	47.2	26	148	90	37.3	Present	Present	Absent
43	31.5	29.6	27.4	33	148	86	32.3	Present	Present	Absent
44	30	28	26	32	152	86	25.3	Present	Present	Absent
45	29	27	25	38	158	86	35.3	Present	Present	Absent
46	43	32	27	25	156	92	27.3	Present	Present	Absent
47	51	46	45	32	148	88	27.9	Present	Present	Present
48	52.7	46.5	46.1	24	156	86	35.3	Present	Absent	Present
49	52.7	47.6	43.9	32	166	92	22.2	Absent	Absent	Absent
50	29.5	23.8	23	26	146	90	34.2	Present	Absent	Absent
51	29.5	9.8	15.4	26	110	70	35.1	Absent	Absent	Absent
52	37.8	18.3	17.2	38	126	80	28.6	Absent	Absent	Absent
53	39.8	16.8	19.8	25	122	82	35.4	Absent	Absent	Absent
54	36.5	15.4	17.2	29	118	80	33.3	Absent	Absent	Absent
55	73.1	23	28.5	24	110	76	22.2	Absent	Absent	Absent
56	31.2	16.8	16.1	21	116	82	29.1	Absent	Absent	Absent
57	48.7	20.5	24.1	24	122	74	34.4	Absent	Absent	Absent

S. No.	nausea	swelling	bilirubin total	bilirubin direct	sgot	sgpt	ldh	creatinine	urine dipstick
1	Absent	Present	1.1	1.2	30	28	-	0.5	3+
2	Present	Present	0.1	0.2	25	18	-	0.1	3+
3	Present	Absent	0.1	0.5	22	19	-	0.1	3+
4	Present	Present	1.1	1.2	46	29	-	0.3	3+
5	Present	Present	1.1	1.2	36	32	-	0.6	3+
6	Present	Present	19	0.7	16	9	223	0.53	1+
7	Present	Present	0.5	0.1	60	13	-	0.5	3+
8	Absent	Absent	1.2	1.1	46	50	-	1.1	3+
9	Absent	Absent	0.2	0.5	34	39	-	0.5	1+
10	Present	Present	0.3	0.15	41	54	-	0.5	1+
11	Present	Absent	1.1	1.6	56	40	-	1.2	3+
12	Present	Present	2.4	2.1	120	210	-	1.1	1+
13	Present	Present	0.6	0.3	42	23	-	0.6	4+
14	Absent	Absent	0.4	0.09	114	84	-	0.3	2+
15	Present	Absent	0.2	0.1	26	21	-	0.47	3+
16	Present	Present	0.74	0.16	52	32	-	1.4	2+
17	Present	Absent	0.3	0.1	93	92	-	0.4	1+
18	Present	Present	0.3	0.04	15	26	-	0.4	3+
19	Present	Absent	1.1	1.5	38	33	-	0.5	2+
20	Absent	Absent	1	1.1	35	42	-	0.9	3+
21	Absent	Present	0.2	0.8	52	60	-	0.3	3+
22	Present	Absent	0.8	0.1	281	147	879	0.6	3+
23	Absent	Absent	0.3	0.8	35	36	-	0.3	3+
24	Present	Absent	0.2	0.1	27	22	-	1.1	3+
25	Present	Absent	1.1	0.8	34	26	-	0.8	3+
26	Present	Present	1.6	1.5	47	59	-	1.4	2+
27	Present	Present	1.1	1	24	38	-	0.8	4+
28	Absent	Absent	0.9	1	38	39	-	0.6	1+3+
29	Absent	Absent	1.4	0.6	27	39	-	0.7	3+
30	Present	Absent	0.9	1.4	29	34	-	0.1	2+
31	Absent	Present	1	1.3	45	76	-	0.8	3+
32	Present	Present	1.1	1.3	58	56	-	1.5	1+
33	Absent	Present	1.2	0.9	36	39	-	0.4	3+
34	Absent	Absent	1.1	0.9	47	39	-	0.7	3+
35	Present	Absent	0.7	0.6	38	47	-	0.8	3+
36	Present	Absent	1	1.2	28	39	-	0.6	3+
37	Absent	Absent	1	0.9	28	34	-	0.4	1+
38	Absent	Present	1	0.6	50	67	-	0.8	2+
39	Absent	Absent	1.1	0.9	24	36	-	0.6	3+
40	Absent	Present	1.1	0.2	35	47	-	1.1	1+
41	Absent	Absent	1.1	0.8	26	34	-	0.5	3+
42	Present	Present	1.1	0.7	36	24	-	0.6	2+
43	Absent	Absent	1.1	0.2	48	37	-	0.5	3+
44	Absent	Present	0.8	0.7	47	58	-	0.8	3+
45	Absent	Present	1.4	0	27	39	-	1.2	3+
46	Absent	Absent	1.1	0.7	58	39	-	1.1	2+
47	Absent	Absent	-	0.4	47	39	-	0.6	2+
48	Present	Present	0.9	0.8	58	39	-	0.6	2+
49	Present	Absent	0.9	0.8	54	39	-	0.8	3+
50	Present	Absent	1.1	0.6	42	58	-	1.1	1+
51	Absent	Absent	1.1	1.2	21	22	-	0.3	nil
52	Absent	Absent	1	1.1	24	31	-	1	nil
53	Absent	Absent	1.1	1.6	26	27	-	0.6	nil
54	Absent	Absent	0.8	0.7	25	36	-	0.4	nil
55	Absent	Absent	0.6	0.9	14	15	-	1.1	nil
56	Absent	Absent	0.7	0.4	21	24	-	1	nil
57	Absent	Absent	0.8	0.4	14	13	-	0.5	nil

S. No.	MRD Number	Name	pi right eye	pi left eye	ri right eye	ri left eye	pr right eye	pr left eye	psv right eye
58	666499	md	1.59	1.63	0.76	0.73	0.44	0.68	42.8
59	1387888	aa	1.59	2.25	0.76	0.8	0.58	0.52	26.5
60	1398413	bk	2	1.78	0.79	0.76	0.44	0.51	33.1
61	38628	nk	1.37	2.03	0.72	0.86	0.45	0.46	48.4
62	337171	sk	1.39	1.44	0.75	0.72	0.49	0.41	36.5
63	1305792	c	1.63	1.66	0.77	0.8	0.56	0.63	31.5
64	1403861	m	1.72	2.1	0.81	0.77	0.58	0.59	32
65	1404702	am	1.8	1.67	0.77	0.75	0.6	0.56	52.7
66	611944	pk	1.81	1.65	0.77	0.77	0.48	0.5	24.1
67	951659	sb	1.75	2.07	0.7	0.73	0.46	0.48	16.1
68	1406018	sk	1.84	1.9	0.77	0.81	0.52	0.54	17
69	1365099	ag	1.9	1.8	0.81	0.82	0.44	0.46	25.1
70	1406983	gs	1.88	1.9	0.88	0.76	0.42	0.44	24
71	1302250	rk	1.44	1.86	0.87	0.89	0.44	0.42	33.5
72	1131959	s	1.42	1.68	0.88	0.89	0.44	0.46	42.3
73	1409469	lk	1.89	1.89	0.86	0.76	0.58	0.56	41.1
74	1409715	pk	1.84	1.74	0.88	0.99	0.54	0.48	35.4
75	472666	vd	2.01	1.81	0.86	0.87	0.54	0.56	27.2
76	1408266	mk	1.88	1.89	0.88	0.74	0.56	0.47	27.1
77	140883	pk	2.2	1.6	0.74	0.86	0.54	0.56	28.5
78	1320450	ak	2.1	1.67	0.74	0.76	0.54	0.62	29.1
79	1413677	rk	1.64	1.88	0.76	0.84	0.56	0.54	29.8
80	1413575	jl	1.58	1.68	0.74	0.99	0.54	0.48	33.5
81	1416519	rp	1.74	1.88	0.98	0.88	0.52	0.54	13.1
82	1416786	hk	2.11	1.86	0.86	0.9	0.44	0.59	12.1
83	1014579	lk	1.8	1.9	0.74	0.57	0.46	0.56	24.1
84	1063627	sd	2.4	1.75	0.96	0.98	0.47	0.58	28.5
85	1422639	ak	1.76	1.58	0.98	0.97	0.56	0.58	27.5
86	298497	gk	1.68	2.22	0.85	0.98	0.44	0.56	25.1
87	242117	sk	1.88	1.96	0.76	0.99	0.58	0.54	26.1
88	1427439	s	1.6	1.87	0.87	0.89	0.58	0.56	27.1
89	1428530	ej	2	1.96	0.74	0.76	0.54	0.57	28.5
90	1430779	vj	1.96	2.22	0.78	0.84	0.46	0.52	29.1
91	181300	sj	2	1.74	0.88	0.99	0.48	0.64	29.1
92	1434686	sk	2.2	2.1	0.87	0.74	0.56	0.57	29.8
93	9008	mk	1.89	1.58	0.98	0.77	0.56	0.54	27
94	1437888	s	2.4	1.8	0.88	0.77	0.54	0.55	28
95	1439263	kk	1.8	2.4	0.91	0.86	0.54	0.44	29
96	1440292	nk	1.9	1.9	0.84	0.74	0.48	0.45	30
97	1337062	kk	1.88	1.98	0.78	0.87	0.41	0.42	29
98	1340597	v	1.47	1.87	0.87	0.88	0.45	0.47	44
99	1445362	hk	1.49	1.27	0.72	0.67	0.44	0.48	45.4
100	8251	hk	1.47	1.51	0.7	0.73	0.52	0.54	28

S. No.	psv left eye	pdv right eye	pdv left eye	age	SBP	DBP	pog	Headache	epigastric pain	visual disturbance
58	41.1	22.7	21.1	34	122	86	26.1	Absent	Absent	Absent
59	28.5	12.1	14.3	32	114	80	37.2	Absent	Absent	Absent
60	34.8	16.8	17.6	24	108	74	35.1	Absent	Absent	Absent
61	48.1	36.6	41	34	126	76	28.3	Absent	Absent	Absent
62	23.9	17.9	16.1	21	122	82	23.1	Absent	Absent	Absent
63	38.1	17.9	19	25	126	78	29.4	Absent	Absent	Absent
64	39	18	20	34	122	82	24.3	Absent	Absent	Absent
65	45.7	29.6	27.8	22	126	72	30.2	Absent	Absent	Absent
66	43.8	12.1	21.2	25	130	82	36.2	Absent	Absent	Absent
67	25.2	8.2	7.5	22	118	76	22.4	Absent	Absent	Absent
68	26	9	8	31	126	74	24.3	Absent	Absent	Absent
69	42.1	12.1	28.1	33	128	78	32.4	Absent	Absent	Absent
70	40	11	26	26	114	76	33.3	Absent	Absent	Absent
71	30.2	17	16.1	24	124	72	32.3	Absent	Absent	Absent
72	37.9	19	17.1	24	112	74	25.4	Absent	Absent	Absent
73	47.1	22	23.1	28	114	82	33.4	Absent	Absent	Absent
74	38.8	17.1	19.1	27	122	78	33.3	Absent	Absent	Absent
75	31.1	15	13.9	24	124	78	22.3	Absent	Absent	Absent
76	30.2	14.1	14.1	28	108	84	33.3	Absent	Absent	Absent
77	31.2	13.9	14.1	27	110	74	34.3	Absent	Absent	Absent
78	37.2	14.1	18.3	25	108	72	27.4	Absent	Absent	Absent
79	37.1	14	18.5	21	110	76	32.3	Absent	Absent	Absent
80	31.1	18.1	16.2	28	114	82	32.3	Absent	Absent	Absent
81	25.1	9	8.1	21	118	76	28.3	Absent	Absent	Absent
82	24.1	8	8	20	114	74	31.3	Absent	Absent	Absent
83	43.8	12.1	21.5	25	106	74	26.3	Absent	Absent	Absent
84	31.2	13.9	14	32	106	76	24.4	Absent	Absent	Absent
85	30.5	14.1	13.5	26	114	84	25.4	Absent	Absent	Absent
86	30.1	13.5	15.1	24	106	74	28.4	Absent	Absent	Absent
87	31.1	14.5	15.6	24	106	68	25.3	Absent	Absent	Absent
88	30	14.1	15.1	31	108	74	28.4	Absent	Absent	Absent
89	35.1	14.1	20.1	25	114	74	37.4	Absent	Absent	Absent
90	36.9	14.2	21.1	24	108	72	25.4	Absent	Absent	Absent
91	37.1	14.1	20.1	25	114	76	26.3	Absent	Absent	Absent
92	38.1	13.9	19	28	112	82	35.4	Absent	Absent	Absent
93	29	15.1	19	25	106	68	33.4	Absent	Absent	Absent
94	31	15.1	18.1	25	114	76	27.3	Absent	Absent	Absent
95	32.1	16.1	19.1	29	114	84	28.3	Absent	Absent	Absent
96	32	16	18	24	108	74	28.4	Absent	Absent	Absent
97	32	15.1	18.1	25	110	68	25.4	Absent	Absent	Absent
98	42	36	35	24	118	74	28.4	Absent	Absent	Absent
99	43.4	37.7	36.2	35	114	72	24.3	Absent	Absent	Absent
100	31.2	14.8	17.6	32	108	72	21.3	Absent	Absent	Absent

S. No.	nausea	swelling	bilirubin total	bilirubin direct	sgot	sgpt	ldh	creatinine	urine dipstick
58	Absent	Absent	0.4	0.6	16	24	-	0.5	nil
59	Absent	Absent	0.4	0.6	14	23	-	0.14	nil
60	Absent	Absent	0.4	0.5	19	15	-	0.7	nil
61	Absent	Absent	1	1.5	24	25	-	1	nil
62	Absent	Absent	1.1	1.5	18	16	-	1.4	nil
63	Absent	Absent	0.5	1.06	19	17	-	1	nil
64	Absent	Absent	0.7	0.8	19	13	-	1.1	nil
65	Absent	Absent	1	1.7	21	24	-	0.9	nil
66	Absent	Absent	1	0.6	21	26	-	0.65	nil
67	Absent	Absent	1.1	0.8	34	36	-	0.7	nil
68	Absent	Absent	0.1	0.8	24	18	-	0.4	nil
69	Absent	Absent	1.1	0.9	19	27	-	0.6	nil
70	Absent	Absent	1	0.5	15	39	-	0.4	nil
71	Absent	Absent	0.9	0.6	24	16	-	0.4	nil
72	Absent	Absent	0.4	0.5	18	16	-	0.7	nil
73	Absent	Absent	0.4	0.7	18	16	-	0.6	nil
74	Absent	Absent	0.5	0.6	14	24	-	0.1	nil
75	Absent	Absent	0.7	0.6	16	14	-	0.6	nil
76	Absent	Absent	1	0.8	14	24	-	0.4	nil
77	Absent	Absent	1.1	0.6	17	26	-	0.6	nil
78	Absent	Absent	0.96	0.5	17	39	-	0.7	nil
79	Absent	Absent	0.4	0.7	35	15	-	0.6	nil
80	Absent	Absent	0.6	0.4	24	31	-	0.5	nil
81	Absent	Absent	0.1	0.6	25	36	-	0.64	nil
82	Absent	Absent	0.7	0.5	36	34	-	0.14	nil
83	Absent	Absent	0.1	0.6	15	17	-	0.35	nil
84	Absent	Absent	0.7	0.2	16	24	-	0.64	nil
85	Absent	Absent	0.9	1	14	24	-	0.47	nil
86	Absent	Absent	0.4	1.1	17	24	-	0.6	nil
87	Absent	Absent	0.9	1.1	16	24	-	0.4	nil
88	Absent	Absent	1.2	1.1	24	26	-	0.7	nil
89	Absent	Absent	1	0.5	24	27	-	0.4	nil
90	Absent	Absent	0.4	0.7	24	26	-	0.17	nil
91	Absent	Absent	0.1	1.2	21	26	-	0.58	nil
92	Absent	Absent	1	1.4	25	34	-	0.47	nil
93	Absent	Absent	1	1.1	24	26	-	0.34	nil
94	Absent	Absent	0.8	0.9	25	36	-	0.25	nil
95	Absent	Absent	1	0.1	24	14	-	0.5	nil
96	Absent	Absent	1.4	1.1	26	14	-	0.8	nil
97	Absent	Absent	1.2	1.1	24	31	-	0.4	nil
98	Absent	Absent	1	1.1	24	21	-	0.6	nil
99	Absent	Absent	1.1	1.2	19	27	-	0.25	nil
100	Absent	Absent	1	1.2	24	15	-	0.14	nil

No. BFUHS 2k21p-111 191

Date 04-11-22

The Principal
DMC, Ludhiana.

Subject: **Approval of Plan of Thesis.**

This is to inform you that the Faculty of Medical Sciences in its meeting held on 29.10.2021 has approved the plan of thesis of **Divyanshu**, a student of your college for **MD Radio-diagnosis** along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis

To study flow changes in maternal ophthalmic artery in cases of preeclampsia and its comparison with normotensive pregnant females.

Supervisor

Dr. Ritu Dhawan Galhotra
Prof.,
Dept. of Radio-diagnosis,
DMCH, Ludhiana.

Co-Supervisor

Dr. Sunil Kumar Juneja
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The student has to submit the four copies of thesis (along with PDF format) , to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She must directed to attach a photocopy of this letter with the forwarding letter while submitting thesis to the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic,(if any).

Dr. S P Singh MS(Oph)
Controller of Examinations

Note :

113. If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.

114. The student may submit the thesis as per the schedule already conveyed i.e for May/June examination 30th Nov of the preceding the year of examination and for Nov/Dec examinations 31st May of the year of examination.

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TO STUDY FLOW CHANGES IN MATERNAL OPHTHALMIC ARTERY IN CASES OF PREECLAMPSIA AND ITS COMPARISON WITH NORMOTENSIVE PREGNANT FEMALES

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED IN

PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MD

In

RADIODIAGNOSIS

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES

FARIDKOT

March, 2021

Dr. Divyanshu

DEPARTMENT OF RADIODIAGNOSIS
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	TO STUDY FLOW CHANGES IN MATERNAL OPHTHALMIC ARTERY IN CASES OF PREECLAMPSIA AND ITS COMPARISON WITH NORMOTENSIVE PREGNANT FEMALES
For the degree of	MD (Radiodiagnosis)
Name of the candidate	Dr. Divyanshu
Supervisor	Dr. Ritu Dhawan Galhotra, Professor, Department of Radiodiagnosis, Dayanand Medical College & Hospital
Co-supervisor(s)	Dr. Sunil Kumar Juneja, Professor, Department of Obstetrics and Gynaecology, DMC&H Dr. Siddharth Prakash, Associate Professor, Department of Radiodiagnosis, DMC&H
Institution	Dayanand Medical College and Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

Introduction: Pre-eclampsia is a multisystem disorder characterized by hypertension in pregnancy (Pregnancy induced hypertension) with proteinuria in a previously normotensive and non-proteinuric woman. It is associated with the various neuro-ophthalmic manifestations, these can be evaluated by Ophthalmic artery doppler velocimetery. Various parameters of Ophthalmic artery Doppler can be calculated which can show the effects PE on cerebral vasculature.

Aim of Study: 1.To study hemodynamic changes in maternal ophthalmic artery by color doppler in cases of PE. 2. To compare the parameters with normotensive pregnant females. 3. To correlate the findings with the severity of the disease.

Materials & methods: Pregnant females who are diagnosed with pre eclampsia and referred for Ophthalmic artery Doppler to Deptt. of radiodiagnosis will be included in the study. Study will be conducted over a period of one year.Linear Probe will be used and Ophthalmic artery doppler parameters will be documented. Inclusion Criteria:1.GA >20 weeks, >140/90 on two measurements taken 6hrs apart, proteinuria >300 mg in a 24 hour urine sample or at least 1+ dipstick, Exclusion Criteria:_1.History of diabetes or chronic hypertension, 2.History of ocular disease 3.History of Vasculitis

Clinical Significance: Ophthalmic artery Doppler can help to detect hemodynamic changes in cases of preeclampsia ,So that prompt intervention can be done to improve the maternal and fetal prognosis .

Keywords: Ophthalmic artery Doppler, Preeclampsia, Eclampsia, Proteinuria

(Signature)	(Signature)	(Signature)	(Signature)	(Signature)
Candidate	Co-supervisor	Co-supervisor	Supervisor	Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"TO STUDY FLOW CHANGES IN MATERNAL OPHTHALMIC ARTERY IN CASES OF PREECLAMPSIA AND ITS COMPARISON WITH NORMOTENSIVE PREGNANT FEMALES"** exist in the Department of Radiodiagnosis, DMC&H, Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis is genuine and is collected by the candidate herself under our supervision and guidance.

Supervisor

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Place : DMC Ludhiana.

Date : 16/3/2021

APPROVAL PROFORMA
BY
RESEARCH & ETHICAL COMMITTEE
DAYANAND MEDICAL COLLEGE & HOSPITAL, LUDHIANA

Name of candidate	Dr. DIVYANSHU
Department	Radiodiagnosis
Topic of Thesis	TO STUDY FLOW CHANGES IN MATERNAL OPHTHALMIC ARTERY IN CASES OF PREECLAMPSIA AND ITS COMPARISON WITH NORMOTENSIVE PREGNANT FEMALES
Likely date of appearing in PG examination	June 2023
Date of enrollment	25th July 2020
Name of Head of Department	Dr. Kavita Saggar
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Signature of Members of Research Committee with Stamp	**Signature of Members of Ethics Committee with Stamp**
Dr. Harpreet Kaur (Professor & Head, Pathology)	Mr. R K Sharma (Legal Expert)
Dr. Jaspal Singh (Professor & Head, Surgery)	Dr. Ramit Mahajan (Associate Professor, Gastroenterology)
Dr. Dinesh Gupta (Professor & Head, Medicine)	Dr. Anu Sharma (Professor, Anatomy)
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	Dr. Gagandeep Singh (Secretary, Ethics Committee Professor & Head, Neurology)

Approved: Yes / No

Dr. Sandeep Puri
Chairperson
Research Committee

Approved: Yes / No

Prof. Arvind Malhotra
Chairperson
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BABA FARID UNIVERSITY OF HEALTH SCIENCES, FARIDKOT

PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

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3	COURSE OF STUDY AND SUBJECT	MD Radiodiagnosis
4	DATE OF ADMISSION OF COURSE	25th JULY 2020
5	TITLE OF THE TOPIC	TO STUDY FLOW CHANGES IN MATERNAL OPHTHALMIC ARTERY IN CASES OF PREECLAMPSIA AND ITS COMPARISON WITH NORMOTENSIVE PREGNANT FEMALES

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Hypertension is one of the most common complications during pregnancy. It encompasses a group of conditions named preeclampsia, eclampsia, chronic hypertension and gestational hypertension[1] complicating 10% of all pregnancies.[2]

Preeclampsia is a major cause of maternal death, IUGR and most of these deaths result from brain damage. In addition to related mortality and morbidity, PE contributes to the adverse long term cardiovascular sequelae of affected women.[3,4]

Pre-eclampsia is a multiorgan disease characterized by hypertension in pregnancy (Pregnancy induced hypertension) with significant amounts of protein in the urine. [5]

It is defined as elevated blood pressure >140/90mmHg taken on two consecutive occasions at least 6 hours apart and the presence of proteinuria >300 mg in a 24 hour sample (or 1+ on dipstick random urine test) after 20 weeks in a previously normotensive and non proteinuric woman that resolves 6wk postpartum. It can be classified into mild and severe forms depending upon various lab and clinical parameters.[6,7]

Untreated PE can lead to Eclampsia, this is defined as PE complicated with convulsions and or coma. As it is associated with abnormalities in intracerebral blood flow.[8]

The clinical diagnosis include presence of higher BP and proteinuria ,persistent visual disturbance and headache as well as epigastric pain. Symptomatically persistent headache and persistent visual disturbance have been documented as sufficient criteria to identify worsening of a pre eclamptic condition. Visual symptoms can occur in 30 to 100% of patients with PE.[9]

Although its pathophysiology is still not entirely understood, it is certain that preeclampsia involves endothelial dysfunction with vasospasm, arterial constriction, reduced intravascular volume and impairment of

organ perfusion.[10,11] This can lead to hemodynamic changes that can affect the internal carotid, ophthalmic artery circulation which can result in neuro-ophthalmic manifestations.

So the ophthalmic artery doppler can be useful for evaluating the intracranial vascular dynamics in PE due to the fact that it has similar embryologic origin to that of the intracranial vessels and has anatomical continuity with the intracerebral circulation.[12,13]

MRI can be safely used to study intracranial blood flow in pregnancy, however it is not readily available or cost effective and is contraindicated such as those with ferromagnetic implants. Other modalities such as CT angiography and radionuclide imaging makes use of ionising radiations which can be hazardous to fetus and therefore contraindicated in pregnancy.[14]

The transcranial doppler ultrasound can be the other modality to study intracranial vessels. however it is not simple to use and has poor spatial resolution.[14]

So, Ophthalmic artery doppler is the best modality to study hemodynamic changes in cerebral vessels and can help to assess the cerebral effects of preeclampsia.

It is safe in pregnancy, cheap, readily available ,portable ,repeatable and non invasive.The lack of bony, fatty or gaseous structures in the eyeballs makes insonation of the ophthalmic artery by transorbital route technically feasible.

Various parameters can be calculated by Ophthalmic artery doppler such as Peak systolic velocity (PSV), Peak diastolic velocity (PDV), Resistive Index (RI), Pulsatility index (PI), Peak Ratio (PR).

These are objective parameters which are not operator dependent which will also remove interobserver variability associated with other modalities.

These parameters can be used to detect pre eclampsia and can predict its severity, so that appropriate intervention can be made to decrease the morbidity and mortality associated with it.

The continued monitoring during pregnancy and recording baseline

parameters can help to detect worsening during the antenatal period which will not only be life saving for mother but can also decrease neonatal mortality rate and other adverse effects of PE on neonates.

6.2 REVIEW OF LITERATURE

Various studies have been done to study the role of ophthalmic artery hemodynamics in pre eclamptic patients.

I. Sapantzoglou et. al. (2021) has done a prospective observational study of women attending for a routine hospital visit at 19 + 1 to 23 + 3 weeks' gestation. This visit included recording of maternal demographic characteristics and medical history, ultrasound examination for fetal anatomy and growth, assessment of flow velocity waveforms from the maternal ophthalmic arteries, and measurement of MAP, UtA-PI, serum PlGF and serum sFlt-1. Waveforms were obtained from the ophthalmic arteries in sequence from the right eye, left eye and again from the right and then left eye. We recorded the average of the four measurements, two from each eye, for the following four indices: first peak of systolic velocity; second peak of systolic velocity; PI; and the ratio of the second to first peak of systolic velocity (PSV ratio). The measurements of the four indices were standardized to remove the effects of maternal characteristics and elements from the medical history. The competing-risks model was used to estimate the individual patient-specific risks of delivery with PE at < 37 and ≥ 37 weeks' gestation and to determine the area under the receiver-operating-characteristics curve (AUC) and detection rate (DR), at a 10% false-positive rate (FPR), in screening by a combination of maternal demographic characteristics and medical history with biomarkers. The modeled performance of screening for PE was also estimated

They observed that the study population of 2853 pregnancies contained 76 (2.7%) that developed PE, including 18 (0.6%) that delivered with PE at < 37 weeks' gestation. The ophthalmic artery PSV ratio was significantly increased in PE pregnancies, and the PE effect depended on gestational age at delivery; the deviation from normal was greater for early than late PE. The second peak of systolic velocity was also increased in PE pregnancies, but the effect did not depend on gestational age at delivery. The other two ophthalmic artery indices of

first peak of systolic velocity and PI were not significantly affected by PE. The PSV ratio improved the prediction of preterm PE provided by maternal factors alone (from 56.1% to 80.2%), maternal factors, MAP and UtA-PI (80.7% to 87.9%), maternal factors, MAP, UtA-PI and PlGF (85.5% to 90.3%) and maternal factors, MAP, UtA-PI, PlGF and sFlt-1 (84.9% to 89.8%), at a FPR of 10%. The PSV ratio also improved the prediction of term PE provided by maternal factors alone (from 33.8% to 46.0%), maternal factors, MAP and UtA-PI (46.6% to 54.2%), maternal factors, MAP, UtA-PI and PlGF (45.2% to 53.4%) and maternal factors, MAP, UtA-PI, PlGF and sFlt-1 (43.0% to 51.2%), at a FPR of 10%. The empirical results for DR at a 10% FPR were consistent with the modeled results. The second peak of systolic velocity did not improve the prediction of either preterm or term PE provided by maternal factors alone.

They concluded that the Ophthalmic artery PSV ratio at 19–23 weeks' gestation, both on its own and in combination with other biomarkers, is potentially useful for prediction of subsequent development of PE, especially preterm PE, but larger studies are needed to validate this finding.[15]

Onwudiegwu C et al. (2020) have done a case control study of 71 pre eclamptic women and 72 parity matched normotensive women and demonstrated that, there were no significant differences between cases and controls with respect to sociodemographic variables. The mean pulsatility index was 1.35±0.46 in cases and 2.1±0.4 in controls ($p<0.001$); the resistivity index was 0.7±0.18 in cases and 0.83±0.27 among the controls ($p=0.01$). A similar pattern was observed in the peak systolic velocity ($p<0.001$) and the peak ratio ($p<0.001$). There was no significant difference between the groups concerning end-diastolic velocity ($p=0.535$).

They concluded that Preeclamptic women had significantly lower Doppler velocimetery and impedance parameters among preeclampsia cases compared with controls. Ophthalmic artery doppler parameters

could be useful in identifying those women who are likely to suffer PE and its complications.[16]

S R Madina et al.(2020) has conducted a cross-sectional observational study, ultrasound of the uterine and ophthalmic arteries was performed in 60 pregnant women in the 2nd and 3rd trimester of pregnancy to compare the resistive index of these arteries in preeclamptic and normotensive individuals. They found that the mean resistive index of the uterine artery was 0.50 ± 0.08 in normotensive participants and 0.64 ± 0.09 in preeclamptic women, with the *p*-value <0.001. The mean resistive index of the ophthalmic artery was 0.70 ± 0.05 in normotensive participants and 0.63 ± 0.04 in preeclamptic women, with the *p*-value <0.001.

They concluded that there was a significant negative correlation between the resistive index of the uterine and ophthalmic arteries among the patients with preeclampsia and a significant positive correlation among normotensive individuals. Preeclampsia could be easily diagnosed with Doppler ultrasound based on hemodynamic changes in response to vascular changes in the ophthalmic and uterine arteries.[17]

M Sarno et al.(2020) has done a prospective observational study in women attending for a routine hospital visit at 35 + 0 to 36 + 6 weeks' gestation. The visit included recording of maternal demographic characteristics and medical history and assessment of flow velocity waveforms from the maternal ophthalmic artery. Waveforms were obtained in sequence from the right eye, left eye and again from the right and then left eye. They recorded the average of the four measurements, two from each eye, for the following four indices: first peak of systolic velocity; second peak of systolic velocity; pulsatility index; and the ratio of the second to first peak of systolic velocity (PSV ratio). The measurements of the four indices were standardized to remove the effects of maternal characteristics and elements from the medical history. The competing-risks model was used to determine the detection rate (DR) of delivery with PE at any time and at < 3 weeks

after assessment, at a 10% false-positive rate (FPR), in screening by maternal factors alone and a combination of maternal factors and the adjusted value of each of the four ophthalmic artery indices.

They observed that the study population of 2287 pregnancies contained 60 (2.6%) that developed PE, including 19 (0.8%) that delivered with PE at < 3 weeks after assessment. The DR, at 10% FPR, of delivery with PE at any time after assessment by maternal factors was 25.0% (95% CI, 14.7–37.9%), and this increased by 25 percentage points to 50.0% (95% CI, 36.8–63.2%) with the addition of the adjusted PSV ratio ($P = 0.005$); the respective values for delivery with PE at < 3 weeks after assessment were 31.6% (95% CI, 12.6–56.6%) and 57.9% (95% CI, 33.5–79.8%). The other ophthalmic artery indices did not improve the prediction provided by maternal factors alone. There was good correlation between the first and second measurements of PSV ratio from the same eye (right eye $r = 0.823$, left eye $r = 0.840$), but poorer correlation in the first and second measurements between the two eyes (first measurement $r = 0.690$, second measurement $r = 0.682$). In screening by maternal factors and PSV ratio for PE with delivery at any stage after assessment, the estimated DR, at 10% FPR, was 50.0% when the average of four measurements was used (two from each eye), 49.1% when the average of one measurement from each eye was used, 47.3% when the average of two measurements from the same eye was used, and 45.8% when only one measurement was used.

They concluded that Ophthalmic artery PSV ratio at 35–37 weeks' gestation can predict subsequent delivery with PE, especially if this occurs within 3 weeks after assessment. In the assessment of ophthalmic artery Doppler, it is necessary to use the average of one measurement from each eye to minimize variability of measurements.[18]

Olatunji et al.(2015) have also done a case control study with 42 PE patients and 41 controls and concluded that Mean resistivity index, pulsatility index, and peak systolic velocity were significantly lower in pre-eclamptic patients than in the controls. Mean peak diastolic velocity, end diastolic velocity, and peak ratio were significantly higher in the pre-eclamptic group. The receiver operating characteristic curve showed that the resistivity index (sensitivity 75%, specificity 77.8%) could distinguish mild from severe PE while the peak ratio (sensitivity 90.5%, specificity 81.3%) could accurately detect PE.

So, OAD ultrasound can be used to monitor patients with PE for early detection of progression to severe forms before cerebral complications develop and OAD screening of patients at high risk for PE can also detect early changes of hemodynamic derangement.[19]

D. S. Matias et al.(2014) in a prospective cohort study recruited 347 women of whom 40 developed PE.

A comparison of the mean ophthalmic artery Doppler parameter values between women with and those without PE showed statistically significant differences in several parameters: peak systolic velocity, end-diastolic velocity, mean velocity, peak mesodiastolic velocity (PMDV) and peak ratio. After adjusting for confounding variables, only PMDV remained statistically significant ($P<0.001$), with an area under the receiver–operating characteristics curve (AUC) of 0.73. The best cut-off for predicting PE was a PMDV of >22.11cm/s, with sensitivity of 70%, specificity of 75%, positive likelihood ratio of 2.8, negative likelihood ratio of 0.4, positive predictive value of 28% and negative predictive value of 95%. The AUC increased from 0.72 to 0.78 when the PMDV was incorporated into a prediction model based on clinical variables, demonstrating that this marker increased the discriminatory capability of the model.

They concluded that high ophthalmic artery PMDV in the second trimester of pregnancy is an independent predictor of PE[20]

Cristiane Alves de Oliviera et al.(2013) compared OAD indices of 30 women with mild pre eclampsia ,30 women with severe preeclampsia and 30 women with chronic hypertension. The control group consisted 289 normotensive pregnant females. They observed —Significant differences between the resistive index, pulsatility index, and peak ratio in women with severe preeclampsia compared to the other groups. The means ± SDs for the resistive index, pulsatility index, and pulse ratio in women with severe preeclampsia were 0.63 ± 0.09, 1.13 ± 0.31, and 0.89 ± 0.12, respectively. The optimal cutoff values for the resistive index, pulsatility index and the peak ratio for identification of women with severe preeclampsia were determined by the receiver operating characteristic curves to be 0.657, 1.318, and 0.784.

And showed that The peak ratio was the best index for discriminating between severe and mild preeclampsia or chronic hypertension.[21]

Diniz et al. (2008) studies differences in orbital flow in mild and severe pre-eclamptic women and compared with healthy pregnant women. They matched Ophthalmic artery Doppler indices of 20 mild and 20 severe pre-eclamptic with 51 healthy pregnant women. They observed that Statistically significant differences between PR, PSV, and EDV (P=0.0009,P=0.0020,P=0.0001) of ophthalmic artery Doppler in a comparison of women with mild and severe pre-eclampsia. Statistically significant differences were seen between all Doppler indexes of the study group and healthy pregnant women. Ophthalmic PR, PSV, and EDV were significantly higher in severe pre-eclamptic cases but other index parameters did not show any difference.An elevation of diastolic and systolic flow occurred when pre-eclampsia became severe. They concluded that Orbital vascular impedance reduction with orbital hyperperfusion was present in severe pre-eclamptic women compared with mild pre-eclamptic and healthy pregnant women.[22]

Tunahan Ayaz et al.(2003) studied Pulsatility and resistivity indices in 30 mild to moderate preeclamptic females with 30 controls concluded that Ophthalmic artery doppler can be used to detect hemodynamic changes that are not present in normotensive pregnant females.[13]

Y Ohno et. al**.** (1999) Ophthalmic arteries were studied by color-flow Doppler ultrasonography in 118 normotensive pregnant women, 20 gravidas with preeclampsia and no visual symptoms, and 11 with preeclampsia, photophobia, and retinal edema.

They observed that the ophthalmic arterial pulsatility index (PI) correlated negatively with gestational age (y = -0.01x + 1.84, r = -0.41, P<.01). Pulsatility index in preeclamptics with photophobia (0.71+/-0.17) was lowest among the three groups (P<.01) and was highest in normotensive pregnant women (1.41+/-0.21, P<.01). Mean velocity in normotensive pregnant women (0.19+/-0.05 m/second) was highest among the groups (P<.01) and was not significantly different in preeclamptic women with no visual symptoms (0.27+/-0.03 m/second) and with photophobia (0.30+/-0.02 m/second)

They concluded that Preeclamptic women, especially those with photophobia, have orbital vascular vasodilation or hyperperfusion, or both.[23]

6.3 AIMS AND OBJECTIVES OF THE STUDY

1. To study hemodynamic changes in in maternal ophthalmic artery by color doppler in cases of PE
2. To compare the parameters with normotensive pregnant females.
3. To correlate the findings with severity of the disease.

7. MATERIALS AND METHODS

A prospective study will be done on 50 patients with pre-eclampsia referred for Ophthalmic artery doppler to the Deptt. of Radiodiagnosis at DMCH Ludhiana. Normotensive pregnant controls matched for maternal age and gestational age will also be included in the study.

Patient will be examined on LOGIQ E9, or Philips IU22 Machine using a linear probe.

Written consent will be taken from each patient in her vernacular language before making her part of the study and relevant history will be elicited from each patient.

SONOGRAPHIC Evaluation:

A linear high frequency probe will be used to scan the orbit and Ophthalmic artery doppler parameters will be documented. The patient will be placed in a supine position with a slight lateral left turn. Both eyes were closed and after a resting period of 10 min a small amount acoustic gel will be applied. The transducer will then be gently placed horizontally over the upper eyelid and OA will be identified by color doppler. Both Ophthalmic arteries will be examined right before left. Then Ophthalmic artery doppler parameters will be recorded which include PSV, EDV, PDV,RI ,PI.

7.1 Source of Data

The study will be conducted on 50 patients with a clinical diagnosis of pre-eclampsia referred from indoor and outdoor patient department to the department of radiodiagnosis for sonographic evaluation. 50 Normotensive pregnant controls matched for maternal age and gestational age will also be included in the study.

7.2 METHOD OF COLLECTION OF DATA

Pregnant women diagnosed with PE and admitted or are on follow up in Dayanand Medical College and Hospital, Ludhiana will be the participants in the study. The data will be collected by personal interviews / Case Registration file / Investigations done on a routine basis. Details of obstetric history, age, date of last menstrual period,

antenatal history of the current and past medical history will be taken into consideration followed by sonographic evaluation.

INCLUSION CRITERIA:

1. GA >20 weeks, >140/90 on two measurements taken 6hrs apart, proteinuria >300 mg in a 24 hour urine sample or at least 1+ dipstick.

EXCLUSION CRITERIA:

1. History of diabetes or chronic hypertension
2. History of ocular disease
3. History of Vasculitis

Duration of Study/ Number of Cases

50 cases

Outcome:

To analyze hemodynamic changes in Ophthalmic artery doppler in patients with preeclampsia, its comparison with the normotensive pregnant female and its Correlation with the severity of the disease

STATISTICAL ANALYSIS:

Data will be described in terms of range; mean ±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. Comparison of quantitative variables between the study groups will be done using Student t-test and Mann Whitney U test for independent samples for parametric and non-parametric data respectively. For comparing categorical data, Chi square ($\chi 2$) test will be performed and exact test was used when the expected frequency is less than 5. A probability value (p value)less than 0.05 will be considered statistically significant. All statistical calculations will be done using (Statistical Package for the Social Science) SPSS 21version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

The study requires Ultrasound- color doppler on the patients, which is a part of routine antenatal care during pregnancy. This study does not

require any intervention to be conducted on patients or other humans or animals.

7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Attached herewith

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PROFORMA

S.no

SECTION A : BIO-DATA AND VITALS

Name of the patient -

Age: -

MRD Number: -

Husbands Name: -

Address:

Age at marriage: Married for:

VITALS:

Blood Pressure: Pulse Rate

SECTION B : PAST OBSTETRIC HISTORY

Obstetric formula:(GPALS)

Obstetric history(In brief):

SECTION C : CURRENT PREGNANCY

LMP: POG: EDOD:

Family History of Hypertension:

Socio-economic status:

Method of Conception: Natural/ Artificial Reproductive Technique

Presenting Complaints:

Headache:

Epigastric Pain:

Visual disturbances:

Nausea:

Swelling of hands and face:

Signature of Candidate **Signature of Supervisor**

Antenatal History

First Trimester	Second Trimester	Third Trimester

Provisional/Clinical Diagnosis :

SECTION D : INVESTIGATIONS

INVESTIGATION	RESULTS
TLC	
DLC	
Hb	
Platelets/PTI-INR	
Bilirubin(T/D)	
SGOT/SGPT/LDH	
Blood Urea	
S. Creatinine	
Urine Complete Examination	

Other Investigations:

Interpretation:

Signature of Candidate

Signature of Supervisor

SECTION E : COLOR DOPPLER STUDIES

Date:

OPHTHALAMIC ARTERY PARAMETERS:

PARAMETERS:	RIGHT EYE	LEFT EYE
PSV :		
PDV :		
RI :		
PI :		
PR :		

DOPPLER INTERPRETATION:

SECTION F: CONCLUSION FOR THE CASE

Signature of Candidate

Signature of Supervisor

INFORMED PATIENT CONSENT

Date: _____

I.....D/o, W/o, S/o..... .....am willing to participate in the study **"TO STUDY FLOW CHANGES IN MATERNAL OPHTHALMIC ARTERY IN CASES OF PREECLAMPSIA AND ITS COMPARISON WITH NORMOTENSIVE PREGNANT FEMALES"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

....

Signature of the Witness Signature of the patient

Name:

Signature of Candidate **Signature of Supervisor**

मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी/पुत्र/पुत्री _____

निवासी _____

इस शोधकार्य **"TO STUDY FLOW CHANGES IN MATERNAL OPHTHALMIC ARTERY IN CASES OF PREECLAMPSIA AND ITS COMPARISON WITH NORMOTENSIVE PREGNANT FEMALES"** में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ _____

गवाह के हस्ताक्षर रोगी के हस्ताक्षर/अंगूठे का निशान

नाम: नाम:

_____

अन्वेषक के हस्ताक्षर

_____

विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____

"TO STUDY FLOW CHANGES IN MATERNAL OPHTHALMIC ARTERY IN CASES OF PREECLAMPSIA AND ITS COMPARISON WITH NORMOTENSIVE PREGNANT FEMALES" ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

_____ _____

ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

_____

ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

_____

ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ